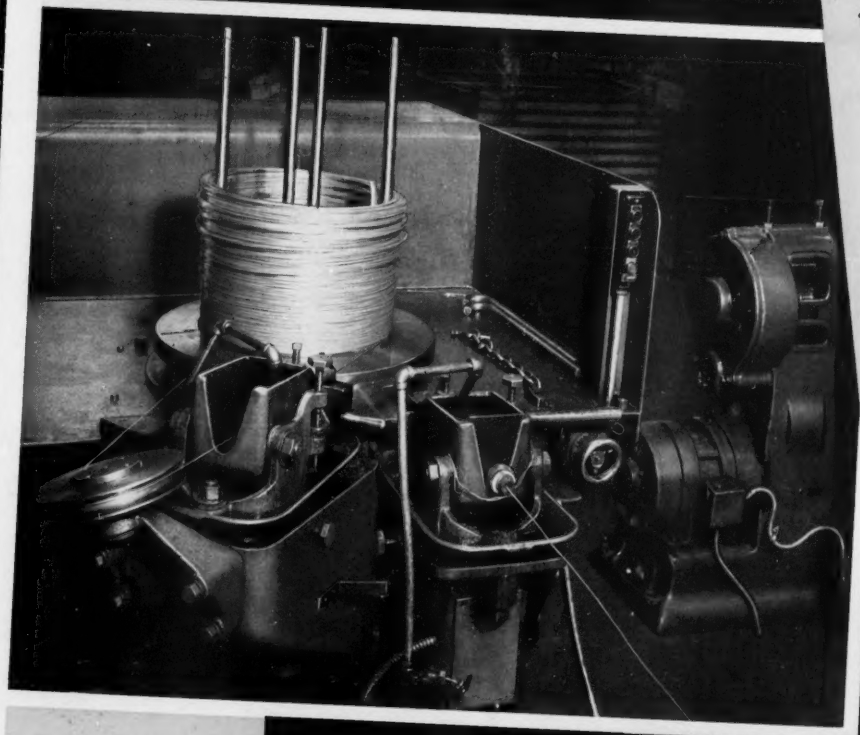
WIRE AND WIRE PRODUCTS

JANUARY 1942

ALUMINUM WIRE.. ANOTHER JOB FOR THE MOTOBLOC!



The *safe high speed* with which Vaughn MOTOBLOC and MOTOBLOX expedite the drawing of aluminum and all other types of non-ferrous and ferrous wire is a powerful asset to defense production in *any* mill today.

Vaughn *flexibility* also will serve these mills with better profits tomorrow, when diversified markets for wire in many metals make new demands upon machinery at the production point.

● No. 15 Double Draw Motobloc, Water Cooled, with No. 1 Pointer

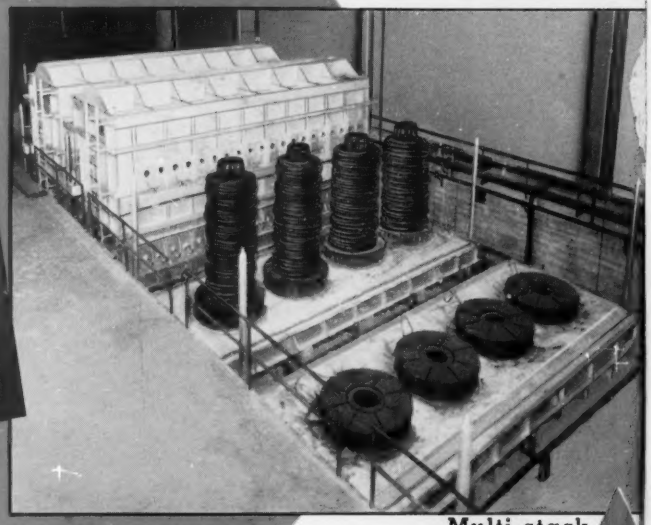
THE VAUGHN MACHINERY COMPANY
CUYAHOGA FALLS, OHIO, U. S. A.

Complete Cold Drawing Equipment . . . Continuous or Single Hole . . . For the Largest Bars and Tubes . . . For the Smallest Wire . . . Ferrous, Non-Ferrous Materials or Their Alloys

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

WILSON FURNACES for RIFLE CLIP STRIP and BULLET CORE ROD (OR BAR) ANNEALING

Multi-stack single row rectangular furnace for rifle clip stock.



Multi-stack single row rectangular furnace for bullet core rods.

Single stack furnace for smaller tonnages and rapid turnover.

STANDARD Wilson bell type furnaces, with only slight changes in design, are suitable for large or small tonnages of the above material—and can be made suitable for general production purposes in the original design.

An Exclusive Development of

LEE WILSON ENGINEERING CO.

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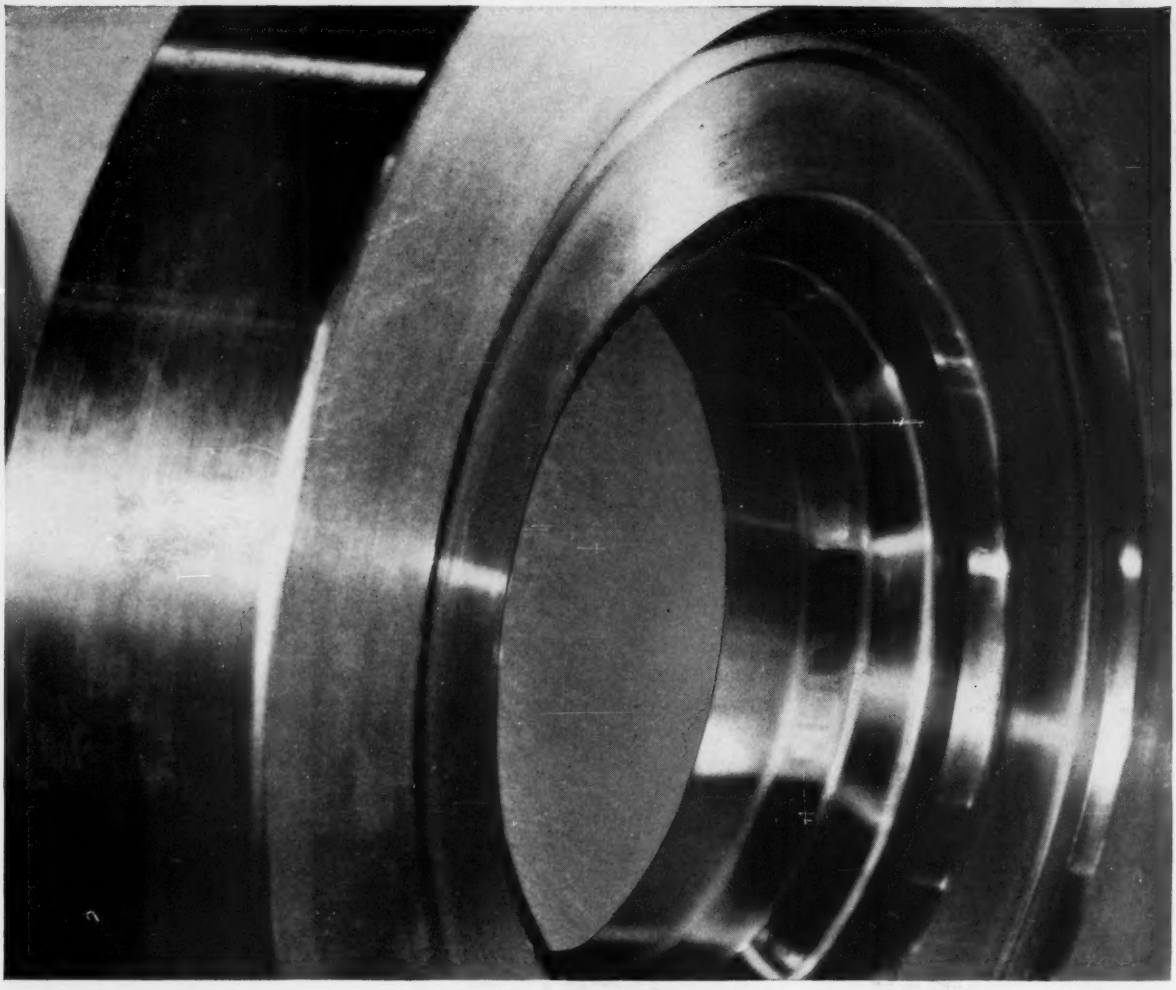
SOLD BY THE WEAN ENGINEERING CO., INC., WARREN, OHIO

• The Wilson Annealing Unit is covered by Patents Numbers 1952402, 2068477, 2078356, 2081612, 2089843, and other patents pending.

Installations completely equipped with atmosphere equipment



The Trend Towards LARGE Carboloy Dies

For Sheet Metal Forming and Drawing

Particularly noticeable during the past year has been the trend toward use of Carboloy dies in large sizes. During 1941, sheet metal forming dies having Carboloy nibs as large as 9¼″ hole size by 11¾″ outside diameter, as well as large sheet metal drawing dies, were successfully employed. Use of these larger dies has been amply justified by better finish, closer tolerances and longer die life.

Anticipating a demand for even larger Carboloy Dies to be used in present Defense work as well as for future civilian requirements, we are now installing facilities for producing Carboloy nibs up to 18″ hole size and 20″ O. D.

CARBOLOY COMPANY, INC., DETROIT, MICH.

CHICAGO • CLEVELAND • NEWARK • LOS ANGELES • PITTSBURGH • PHILADELPHIA • WORCESTER, MASS.

Authorized Distributors: Canadian General Electric Co., Ltd., Toronto, Canada • Hartley Wire Die Company, Thomaston, Conn.

CARBOLOY CEMENTED CARBIDE PRODUCTS

TOOLS · DIES · DRESSERS · CORE BITS · MASONRY DRILLS · WEAR RESISTANT PARTS

FOR THE MANUFACTURING · MINING · TRANSPORTATION · CONSTRUCTION INDUSTRIES

Our Mutual Task

THERE can be no better time than this beginning of 1942 to thank our customers for their unfailing patience and the consideration they have shown in the past twelve months toward our efforts to supply the myriad emergency demands for steel.

Today you as consumers and we as producers of steel have a mutual task of achieving the maximum output of materials for war. We must also produce materials for the indispensable minimum of goods for our domestic economy.

The coming of active warfare has made our mutual task as the year opens increasingly arduous. Bethlehem is exerting the utmost effort to meet unprecedented demands. It is our purpose to serve our Government to the utmost of our ability in this emergency. More than 800,000 tons of steel capacity has already been added, together with accompanying increase in coke ovens and blast furnaces, and expansion of finishing facilities. Further expansions in ingot capacity, and in rolling mills, forges and shops, are anticipated. We are purchasing a wide variety of materials from more than 10,000 suppliers. Our employment rolls have been stepped up to more than 180,000.

With all of this, the demand for our products continues unabated, and 1942 will continue to require the full cooperation and understanding between steel maker and steel user.

It is a gratifying and typical characteristic of American industry that all the needs of our Government and of our national purpose have been met on all sides during the past year with vigor and cheerfulness.

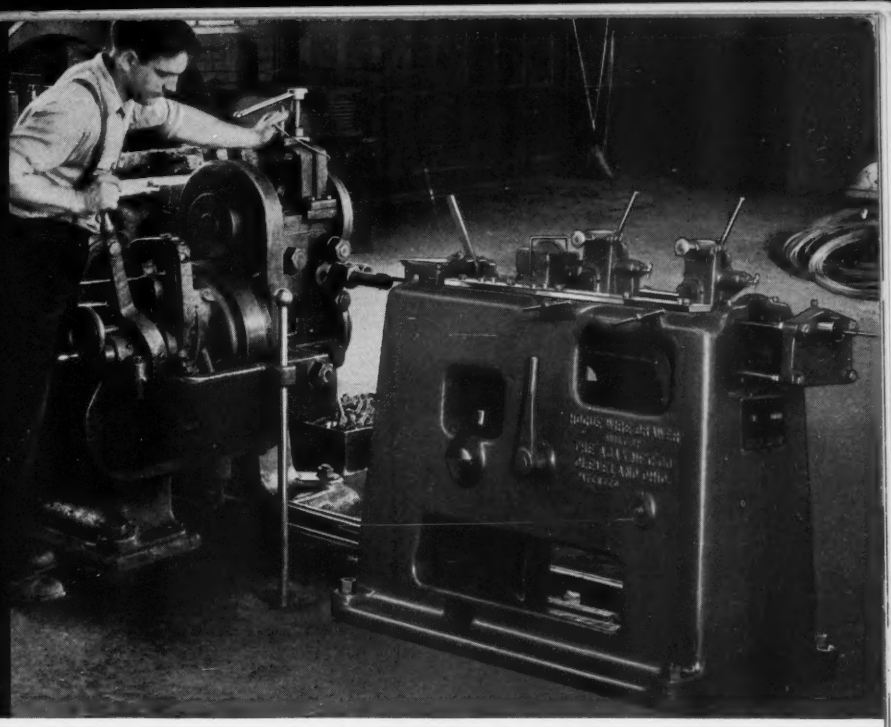
Now is added a still greater and unremitting determination. We know that there will be the whole-hearted cooperation of all, so that what needs be done, shall be done.

"Enough, if something from our hands have power,
To live, and act, and serve the future hour."

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

Lower Costs—Uniform Accuracy—Increased Die Life in Cold Heading Achieved with AJAX-HOGUE WIRE DRAWERS



The Ajax-Hogue Wire Drawers used in conjunction with cold headers make it possible to produce highest quality cold headed products from hot-rolled stock instead of cold-drawn wire, thus saving the difference in the cost of the two materials.

Stock cold-drawn on the Ajax-Hogue Wire Drawer is more accurate than the variation allowed by standard commercial tolerances, and does not vary in size from coil to coil. The wire enters the header straight with a good clean coating immediately after drawing and before age hardening sets in, which makes for easier heading with a resulting substantial increase in heading die life, especially on difficult, close limit products.

All of these factors contribute to the production of a higher quality finished product, at a lower cost, in the production of bolts, screws, and other cold headed products. If you operate cold headers, write for Bulletin No. 111.

★ ★ ★

Cold draws, straightens and shears off, hot rolled coiled stock into straight, accurate blanks of uniform length, from 6 inches to 15 or 20 feet. Diameter 3/16 to 3/4 inch. Write for Complete Information.

NEW AJAX WIRE DRAWING STRAIGHTENING AND CUTTING OFF MACHINE

AJAX ALSO BUILDS CONTINUOUS BAR DRAWING AND STRAIGHTENING MACHINES FOR ROUNDS, HEXAGONS, SQUARES.
Capacity ½" to 1¼".
Bulletin No. 115.

THE AJAX MANUFACTURING COMPANY
EUCLID BRANCH P.O. CLEVELAND, OHIO
621 MARQUETTE BUILDING • CHICAGO, ILLINOIS

·MAKE YOUR RESERVATIONS NOW·

for the 1942 edition

of the

WIRE

& WIRE PRODUCTS'

Buyers Guide

and Year Book

of the

WIRE ASSOCIATION

The only reference book available listing all components of the wire industry, completely indexed.

Invaluable to purchasers of rod, strip, bare and covered wire and cable, cold drawn bars and cold headed products.

Gives sources of machinery, materials and equipment for manufacturers of rod, strip, wire and wire products.

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WRITE AT ONCE FOR FULL DETAILS

TO

WIRE & WIRE PRODUCTS

300 Main Street — Stamford, Conn.

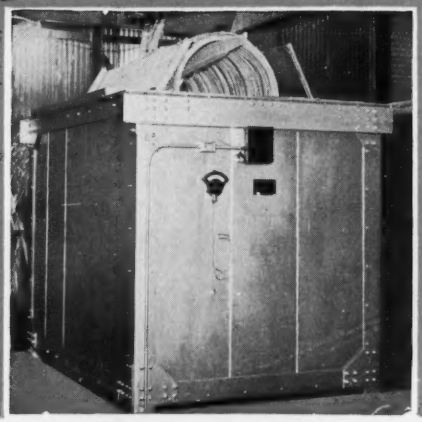
OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

THE *FASTEST* ROD BAKER BUILT!

Carl-Mayer

HI-SPEED
TRADE MARK

ROD BAKER



At Steel Company of Canada's plant at Hamilton, Ontario, the success of this first Carl-Mayer Rod Baker installation quickly resulted in second order.

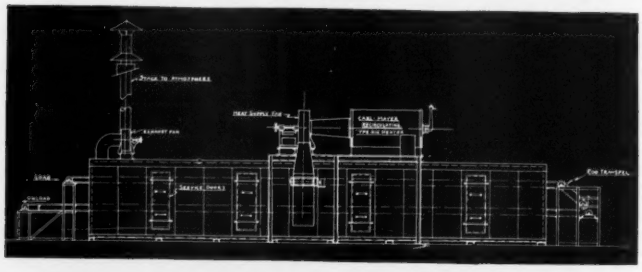
Carl-Mayer Hi-Speed Rod Baker such as installed at Wickwire Spencer Steel Co., Atlantic Wire Co., etc.

PATENT NUMBERS

U. S. A. 2235559. CANADA 396144 AND 465969

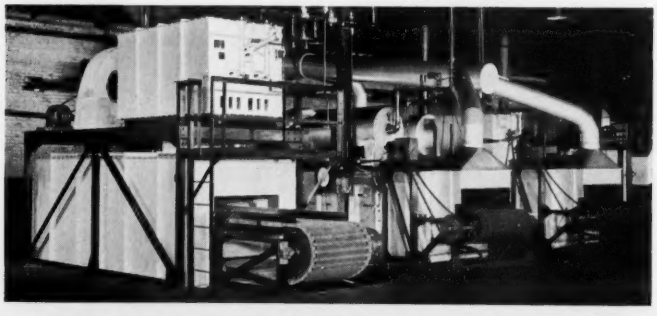
Other patent claims allowed and pending

• • •



CARL-MAYER WELDING ROD OVEN

Carl-Mayer Welding Rod Ovens (similar to this) installed for Page Steel & Wire Co.; Six at Hollup Corp., for drying coated welding rods—using the "Mayer" Recirculating Gas Fired Air Heater Principle and Rod Transfer Systems (patents pending). The policies of users prohibits the use of photographs.



CARL-MAYER INDUSTRIAL FURNACES

For stress relief, drawing, tempering and heat treating a variety of products. Temperatures at 1300°F. Uniformity plus or minus 2½°F. Installations at Timken, Ford Motor, Hyatt, Bridgeport Brass, Heywood Wakefield, Aluminum Co. of America, American Magnesium Corp. and other outstanding concerns.

The Carl-Mayer Rod Baker has an exclusive heater arrangement which insures fast, dependable baking at a saving up to 50% in time and fuel.

And a patented Blow-Off feature removes moisture without bumping or agitating the coils.

Concerns such as listed below, have bought Carl-Mayer Rod Bakers, Wire Bakers, etc., and will back our claims for a big lead in speed, efficiency and fuel economy over competitive makes.

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Allegheny Ludlum Steel Co.
Atlantic Wire Co.
Atlas Steel Co.
Johnson & Nephew, Ltd.
Pittsburgh Tool Steel Wire Co.
Reliance Mfg. Co.
Steel Co. of Canada
Wickwire Spencer Steel Co.

The Carl-Mayer Corporation

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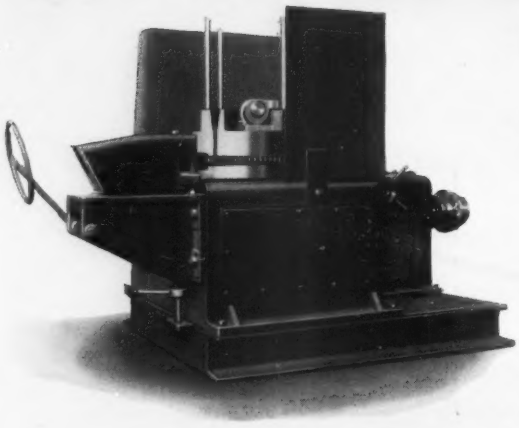
Over 20 Years Experience

ROD AND WIRE BAKERS
INDUSTRIAL FURNACES
WELDING ROD OVENS

Write for Oven and Furnace

Syncro presents



The new A.C. or D.C. variable speed.....

RODBLOCK

The SYNCRO RODBLOCK offers you many important constructional and operating advantages. It can be furnished for the conventional D.C. variable speed drive, or for A.C. drive, in which case various speeds are obtained by means of a highly efficient geared transmission. The RODBLOCK draws either ferrous or non-ferrous metals at high speed and is equipped with modern safety devices.

Single or double deck RODBLOCKS are available. These machines can be furnished with various block diameters to suit all commercial rod sizes. Pull-in grips can be supplied of a type that will not deface the block surface, as well as an efficient air cooling system.

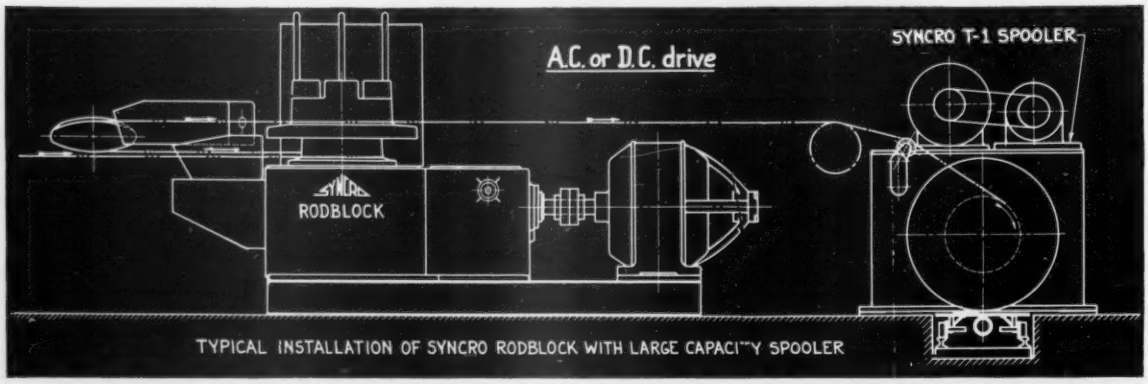
The SYNCRO double deck RODBLOCK can also be supplied with means to facilitate stringing-up on the finishing block, or for running with one die only.

Write for complete details.

SYNCRO · MACHINE · COMPANY

Rahway, New Jersey — McCormick Bldg., Chicago

Represented in Canada by — Canadian Elevator Equipment Co., Ltd., Toronto



TYPICAL INSTALLATION OF SYNCRO RODBLOCK WITH LARGE CAPACITY SPOOLER

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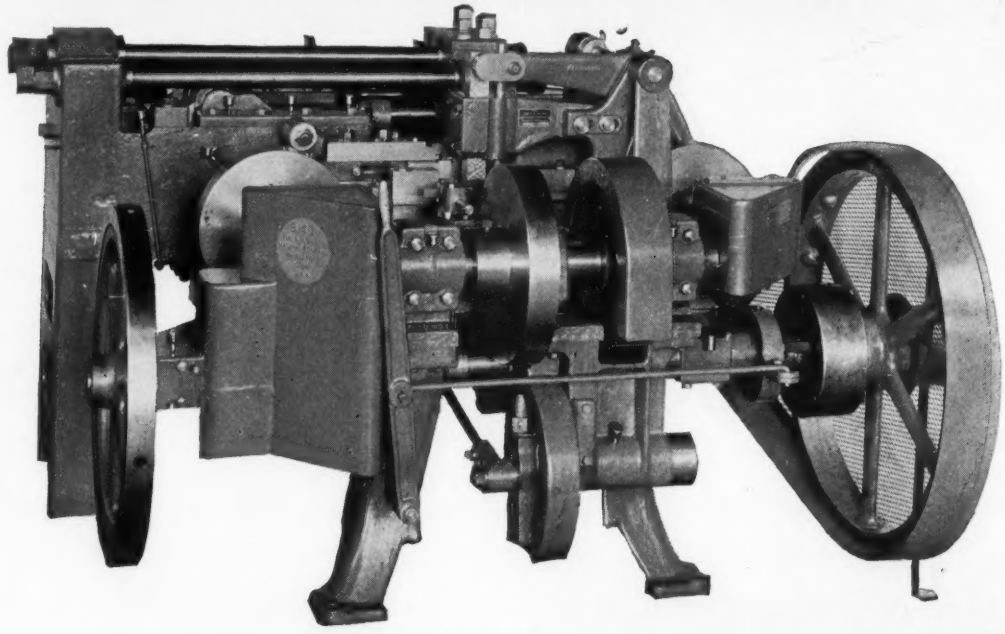
AUTOMATIC PRESS and FOUR SLIDE MACHINE

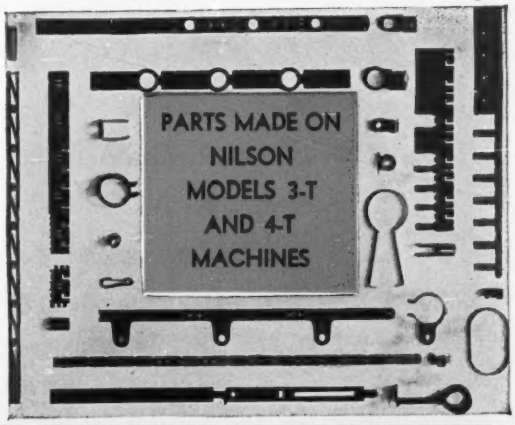
for

SWAGING
STAMPING
PIERCING
BLANKING
FORMING
OF COILED METAL



A General Purpose, Heavy Duty Fabricating and Metal Forming Machine

NILSON Builds machines for forming Paper Clips, Buckles, Gate Hooks, Coat and Hat Hooks, Ceiling Hooks, Wire Ears, Cable Rings, Screw Eyes, Sash Chains, Automobile Side Chains, Flat Open Link Chains, Staples, Cotter Pins, Hose Clamps, Etc., and Wire Straighteners, Wire Reels, Frame Bending Machines and Special Presses. Submit your problem to Nilson.



THE A. H. NILSON MACHINE CO.

BRIDGEPORT, CONN., U.S.A.

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THE "WILL TO DO" FOR VICTORY IS

The thunderous stream of steel is flowing swiftly at J&L, and in greater volume and finer quality than ever before. The "will to do" for victory has inspired the men of all departments and divisions of the organization to quicken the tempo of production. These men — thirty-five thousand strong — working with foremen, superintendents, executives who themselves came up from the ranks — are establishing many new all-time production records.

New "highs" have been made in the mining and lake shipping of iron ores from subsidiary properties in the Lake Superior region; in the mining and river shipping of coal from the company's mines in Western Pennsylvania; and in the handling of materials by subsidiary railroads. Twenty-four hours a day, seven days a week at the steel plants these raw materials are being converted into more coke in by-product ovens, as well as more by-products essential to defense; into more iron in towering blast furnaces; more steel in Flame Controlled Bessemer converters and open hearth furnaces. Day after day, night after night, turn after turn, mill crews go after records

JONES & LAUGHLIN

AMERICAN IRON

PITTSBURGH,

J & L — PARTNER TO

FROM AN ORIGINAL DRAWING BY ORISON MACPHERSON

PRODUCING MORE STEEL AT J&L

that seemed unbeatable, and set up many new ones, while producing millions of tons of Controlled Quality steel products for American industry to apply to all the vast stores of *matériel* and materials so urgently required for the upbuilding of this Nation's armed strength and fighting power in a war-torn world.

These goals are being reached by the full employment of all steel-making facilities, and the men that man them, augmented by the various offices and the services stemming from them, by sound engineering, by the invention and adoption of new devices and better methods—holding fast all the while to the control of quality that marks every ton of steel produced.

Through all this increased pace of production the men are going about their jobs with splendid teamwork, making new safety records, keeping their work among the safest in the whole field of industry. Meanwhile the men in research count this period as one in which to learn and plan for a new era when steel will more fully serve mankind in the creation of a new world, a free world, a better world in which to live.

STEEL CORPORATION

AND STEEL WORKS

PENNSYLVANIA

INDUSTRY FOR VICTORY

J&L STEEL

UPRIGHT ★ ★ ★

★ ★ ★ CONE

Wire Drawing Machines

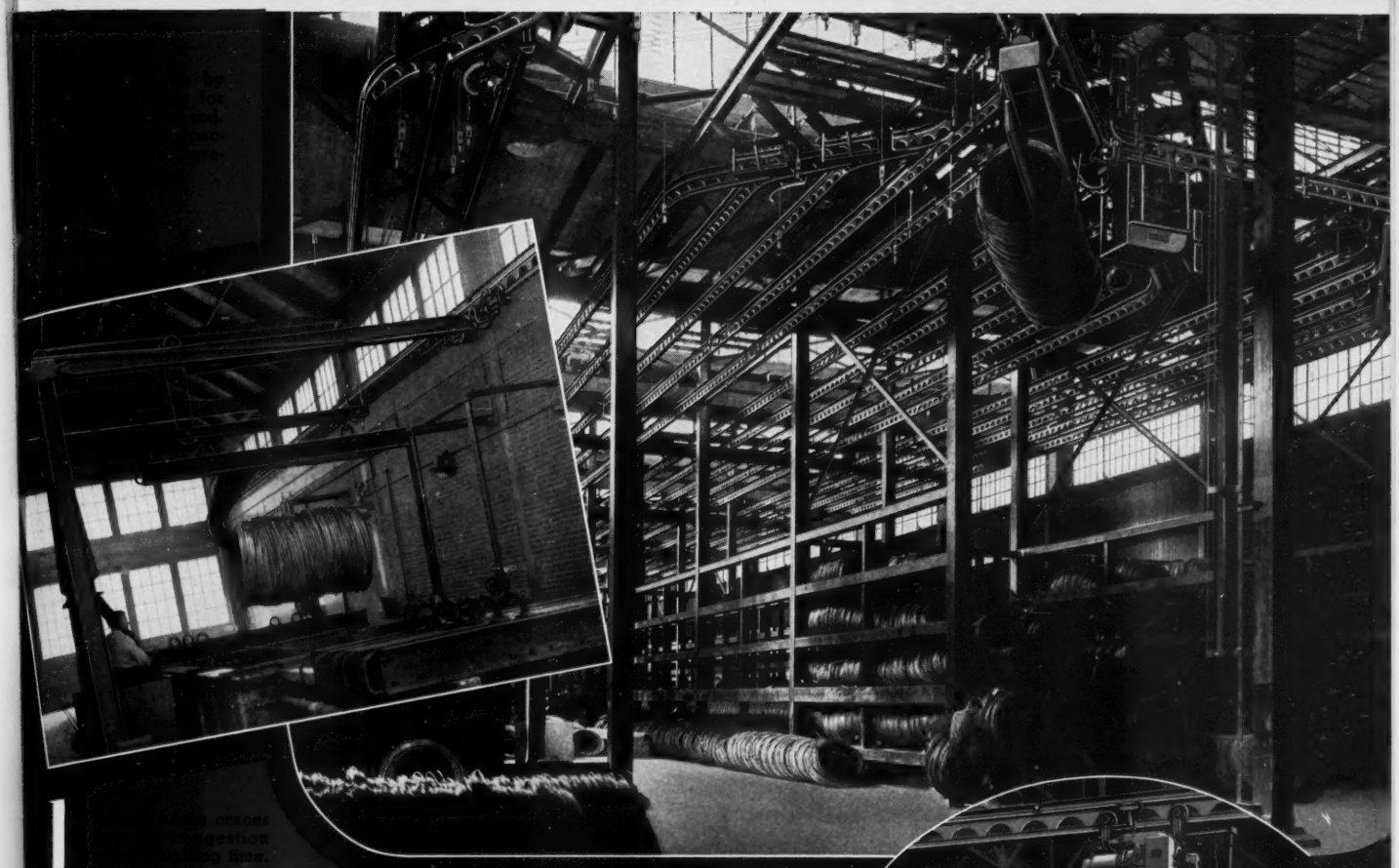
FOUNDED WATERBURY FARREL 1851

These high speed machines are available in several sizes and can be had with either a coiling block or spooler. The spooler may be an attachment or a separate floor-type device, such as shown. This is the No. 4 machine with belt-type cradle spooler. It is driven by a direct-coupled motor (not shown), has 13 dies and capacity for drawing copper from ¼" maximum starting size down to a finishing size of from No. 10 to No. 18 B. & S. gage. The dies and the hardened steel drawing rolls are enclosed by a rolling steel curtain to confine the splash of the drawing lubricant.

WATERBURY-FARREL
FOUNDRY & MACHINE COMPANY
Waterbury, Connecticut, U. S. A.
SALES OFFICES CHICAGO CLEVELAND NEWARK, N. J.

GREATER PRODUCTION

PLANT EXPANSION

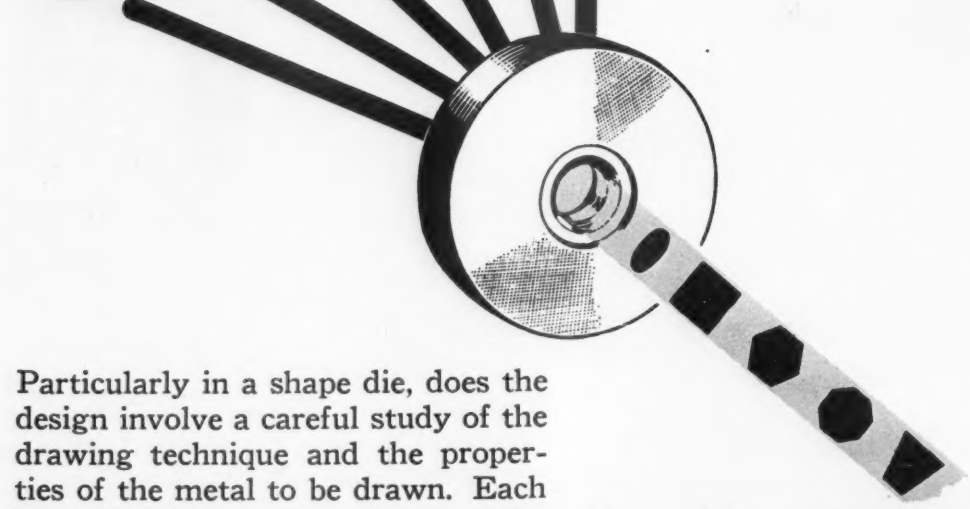


CLEVELAND TRAMRAIL

Vascoloy RAMET
T M REG U. S. PAT OFF

design in

SHAPE DIES for HIGH PERFORMANCE



Particularly in a shape die, does the design involve a careful study of the drawing technique and the properties of the metal to be drawn. Each Vascoloy-Ramet shape die or special purpose die is "custom built" for maximum performance in its particular function.

These shape dies are obtainable rough cored or finished. By our exclusive process rough cored dies are made close to final dimension, requiring minimum finishing time. Finished dies are lapped and polished to unusual smoothness and close tolerance. They are furnished ready to use.

The staff of our die department is glad to consult with you for maximum die performance. This service is as near as your telephone.

VASCOLOY-RAMET CORPORATION
NORTH CHICAGO, ILLINOIS

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423

THE SUPERIOR TANTALUM-TUNGSTEN CARBIDE DIES

WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 17 JANUARY, 1942 No. 1

Designated as

Official Publication By The Wire Association

Contents

The Shape of Things to Come ..... By Kenneth B. Lewis 15
(The Mordica Memorial Lecture—1941)

Continuous Process for Rubber Insulating Wire ..... By J. Z. Linsenmeyer 29

Wire Association Proceedings 32

Outstanding Personalities in the Wire Industry 45

American Iron & Steel Institute Statistics—October, 1941 46

Exports & Imports of Wire 47

Wire Association Attendance List 1941 Convention 50

A Review of Recent Wire Patents 62

Outline of Canadian Price and Wage Control 64

Index to Advertisers 76

Where to Buy 76-80

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STEVENS

LOW TARE SHIPPING REELS AND FLANGED STEEL DRUMS . . . .

FOR

LOW WEIGHT AND LONG LIFE ECONOMIES . . . .

THE Stevens customer quoted above also stated, "They not only take up less room but are considerably easier to handle."

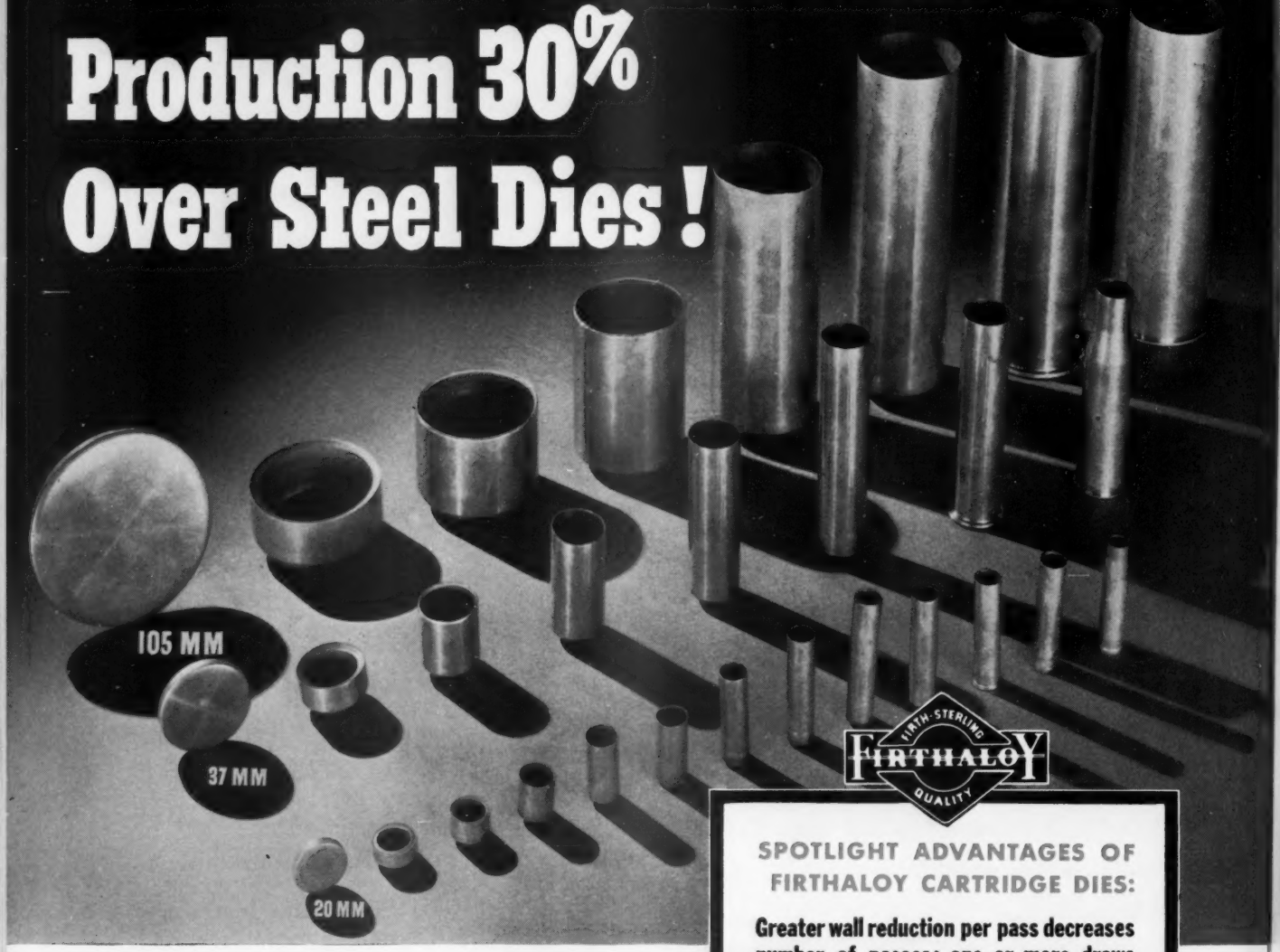
Stevens reels are built to last — sturdy at the hub, and engineered with shock absorbing characteristics to withstand side stress.

Write for interesting data and prices.

Manufactured under license arrangements with Western Electric Company, Incorporated

THE STEVENS METAL PRODUCTS CO., NILES, OHIO

FIRTHALOY* Boosts Shell Case Production 30% Over Steel Dies!



We're in a war. Speed-up of shell case manufacture is imperative!

FIRTHALOY solid or sectional Carbide Dies *definitely increase shell case production* 30% *to* 35%! For this vital manufacturing need FIRTHALOY Cupping and Drawing Dies have proved their productive superiority on cases from 20 mm. to 105 mm. diameter. The advantages of FIRTHALOY dies apply equally to small arms cartridge cases . . . for drawing, loading, pointing, tapering, heading and other requirements.

FIRTHALOY engineers will help you adapt them to your needs.

**FIRTHALOY is a Sintered Tungsten Carbide.*

SPOTLIGHT ADVANTAGES OF FIRTHALOY CARTRIDGE DIES:

Greater wall reduction per pass decreases number of passes; one or more draws eliminated.

Smoother, scratch-free finish and higher quality results in fewer rejects.

From disc to case 30% to 35% faster with cheaper shell for shell cost.

Less give, sink and wear because of FIRTHALOY'S near-diamond hardness and remarkable resistance to abrasive wear.

Longer runs; less unproductive down-time; greatly reduced die cost.

FIRTH-STERLING STEEL COMPANY

OFFICE AND WORKS:
McKEESPORT, PA.
BRANCH WAREHOUSES:
NEW YORK CHICAGO
HARTFORD PHILADELPHIA
LOS ANGELES DAYTON
CLEVELAND DETROIT

WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING --- EXTRUDING --- FORMING --- FABRICATING

Vol. 17 JANUARY, 1942 No. 1

The Shape of Things To Come

By Kenneth B. Lewis,
Consulting Wire Mill Engineer,
Worcester, Mass.

THE MORDICA MEMORIAL LECTURE
— 1941 —

IN wire technology, as in other departments of human activity, the soundest basis on which to judge the future is the past. Past and present are as the rear sight and front sight of a rifle; project their line and you may judge where the shot will land. This, like all general rules, is subject to many apparent exceptions. The rear sight may be dim and ill-defined, the front sight may wobble, and it may be necessary to allow for considerable dispersal at the target, yet with all these disabilities the study of the history of an art is useful mental exercise and may become an absorbing hobby.

✦ ✦ ✦

I PROPOSE to trace in these pages the history of the various operations which make up wire manufacture, and, whenever I believe I have brought the front and rear sights into line, to predict their future course. It is not an easy task. I have been collecting data for thirty years or more and there is scarcely a date on which I can rely with entire confidence, scarcely an invention to which I can definitely assign a name or a place. Practises sprang up, were adopted tentatively here and there, and died out, only to be "invented" a hundred years later. Ancient and modern methods co-existed in space and time, with no apparent reason. Much of my evidence is circumstantial, some of it susceptible of more than one interpretation, and to get a reasonable degree of clarity in a brief story I shall have to over-simplify.

KENNETH B. LEWIS
MORDICA MEMORIAL LECTURER—1941

Born Bridgewater, Mass., and educated public schools, Quincy, Mass. A.B. Harvard University. From 1904 to 1907 with Bethlehem Steel Company, becoming Asst. Supt. of open-hearth furnaces. From 1907-1909 with the American Steel & Wire Company, Worcester, experimental work on wire. From 1909-1932, Morgan Construction Company, building wire mill equipment. In 1932 established own practice as Consulting Engineer in which occupation he is now engaged.

✦ ✦ ✦

The Wire Rod

THE genesis of the wire rod is implicit in its name. Anywhere but in the wire business a rod is a short, straight, relatively small bar. In the dawn of our craft the rod was a forged bar of wrought iron, about finger size and eight to ten feet long. As hand forges gave way to trip hammers, driven first from cams

IN MEMORIAM

JOHN MORDICA
1873 - 1937

on water-wheel shafts and finally by steam, the rod receiving as many as four blows a second, could be drawn out to nearly thirty feet in length and a quarter inch diameter.

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THE earliest innovation was the split rod. Flats were forged, three to six inches wide, quarter to half inch thick, and were split into rectangular slivers. Early in the life of the rolling mill, which for a long time used flat rolls only, and which for a still longer time was regarded as a device for sizing and smoothing a forged bar rather than a means of working it down, the rod was rolled flat, and split by collared rolls. These operations were conducted in every possible combination; forged bars split by hand, forged bars split by rolls, rolled bars split by hand, rolled bars split by rolls.

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IN any case, the rectangular rods were rounded up on the edges before drawing, and here too every possible combination had its advocates. Some bars were rounded hot by hand hammer, or by tilt hammer, some were rounded cold, and after grooved rolls came into use they were used on both hot and cold stock.

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IT should be remarked, (and could have been predicted) that conservative wire makers distrusted these split rods. Splitting, they declared passionately, "cut the fibres" or "destroyed the life" of the metal. Curiously enough they were probably right. These bars were heated for a light pass in the rolls, re-heated for splitting, and heated again for rounding up. All this heating with so little working must have rapidly done the iron no good.

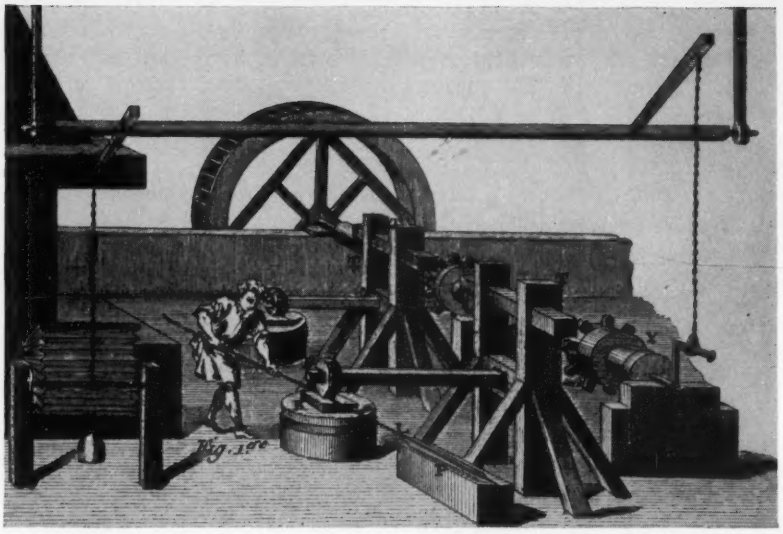

Fig. 1. Forging wire rods, 1750.

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THIS is a good place to comment on the iron. It was, in earliest times, reduced from the ore in one step. A mixture of ore and charcoal heated in a blast of air settled down into a lump of very slaggy iron with God only knows what inclusions. In all early accounts of wire appear the terms **Osemond** iron, **Osmund** iron, or in England, **Osborn** iron. This is believed to be a place-name, but whether Swedish, German, or Belgian, authorities cannot agree. There is general agreement, however, that it was an especially clean, well worked wrought iron, the best obtainable, reserved for wire drawing. It is readily understandable that wire drawing, imposing upon the metal by its very nature the most drastic tests, should command the finest raw material, but it seems odd that these very remote ancestors of ours should have grasped so readily a principle which our contemporaries have not always conceded. I am putting this thought forward as delicately as I can, for the credit and good name of our craft.

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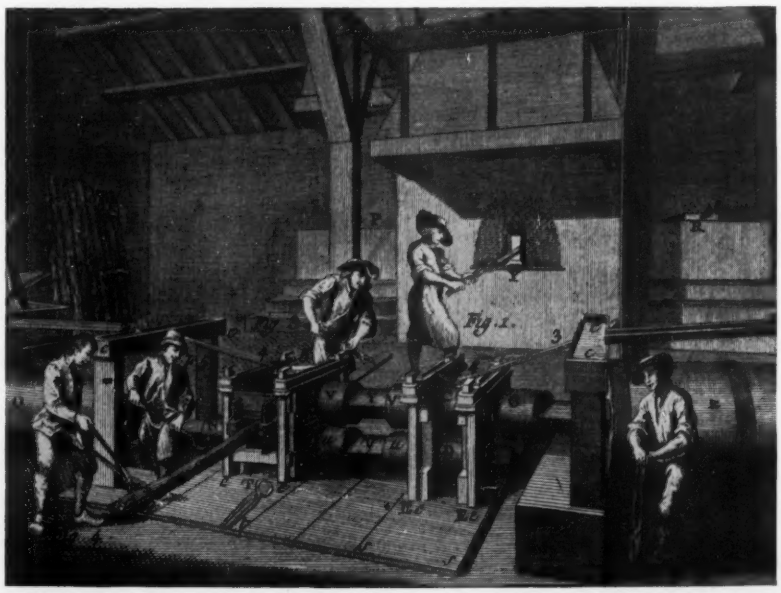

Fig. 2. Splitting flats in collared rolls.

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FOR over a century the rolling mill crept quietly into the industry, being constantly rebuffed, but always coming back. The rolling and collar-splitting of flats can safely be dated about 1700. One reliable date is 1728, at which time a **Mr. Fleuer** of France, made no secret of the fact that he was rolling rods in grooved rolls. He started with a forged oval, which he worked down in alternate

diamond and oval passes to a finished rod at ¼". He may well have been the first to conceive of grooved rolls as the logical means for reducing the section of his rods, as well as the first to work out the diamond-oval progression as the quickest reducing combination. This all went on, it is interesting to note, fifty-five years before **Henry Cort** "originated" the use of grooved rolls. I shall have occasion from time to time to speak of the lawlessness of these early iron-masters, who never scrupled to make use of a process many years before it had been invented.

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DISREGARDING **Fleuer's** developments, which included the production of rods in lengths hitherto unheard of, and the breaking down of these rods on rotating blocks, the world went right on with forged rods, and with split rods, drawn many drafts in straight lengths.

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A ROD mill sketched by **Karstens** in 1828 begins to look fairly modern, with its 3-high rougher and alternate 2-high finishing train. It is a rudimentary **"Belgian train,"** and it finished at 220 RPM. Its sponsors had the bad taste to use a three-high stand twenty-eight years before the invention of 3-high rolling by **Uncle John Fritz** at Johnstown. The rods were still rather short, a 14 lb. bundle being about standard, but looping had already been spoken of, in fact it was practised at a time when all the passes were in the same stand.

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THE big moment in rod rolling came in 1862 when **George Bedson,** of Manchester, England, conceived and built the first continuous mill, and began to roll what were in those days practically unlimited bundle weights. The driving force behind this development, and in fact behind a whole series of changes which came into the industry in this decade, was the electric telegraph. Wire had for centuries been drawn in 8 to 12 lb. pieces, drawn in short straight pulls, until it was small enough to go onto hand driven drums. Coarse wire was merely a semi-product, something to be roughed down for fine wire. There was no market for coarse wire, which was a lucky break because it was not fit for any market. It was covered with grip marks every couple of feet, it was of no particular size, and in pieces almost too short to coil. It is vain to speculate as to which of these circumstances was cause and which was effect; the interesting thing is that the telegraph broke the vicious circle, made a market for coarse wire, and cried aloud for a better product. Its sponsors were fed up with wire that looked as

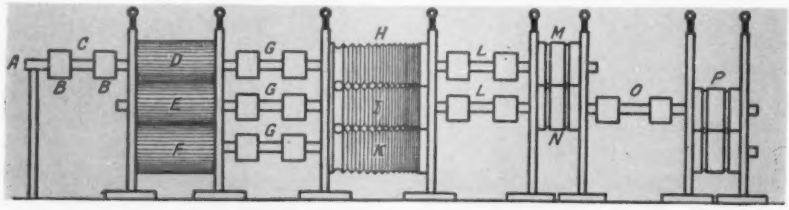

Fig. 3. Sketch by Karstens, 1828.

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though it had been chewed by rats, and required splicing at each 60 or 70 feet.

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THIS is undoubtedly the sort of pressure which led **Mr. Bedson** to build his mill. It was a single-strand mill with alternate horizontal and vertical rolls so as to work the billet in both planes without turning it. It shook down soon into a 14-stand unit, rolling a 1¼" billet to #4, and was good enough to run commercially for 60 years. I saw it in production in 1919. I have had the pleasure of going through a file of manuscript letters which passed between **Mr. Bedson** and **Ichabod Washburn** of Worcester, Mass., during the development of the continuous rod mill. **Mr. Bedson** never doubted that he was revolutionizing rod rolling. "The old system," he says, "must fall." He reports the rolling of a 25 lb. billet to rod in 15 seconds, which he says is one-quarter the usual time, and declares that in place of the usual rod mill crew of six men, his "machine" employed only a man and a boy, for whom substitutes could readily be trained in case of labor trouble. Bundles could be of any desired weight; he confined himself to 50 lb., which was enormous in those times, because he didn't want to overload his engine.

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IN 1864 **Mr. Bedson** quoted **Mr. Washburn** on a continuous rod mill, the price, (hang onto your hats) one thousand pounds sterling. The Yankee thought it over four years, and bought a mill in 1868, setting it up at North Works in Worcester. It rolled excellent rods, about seven tons a shift at first, but gradually rising to fifty tons. The mill was in direct charge of **Charles Hill Morgan,** who stepped up its value immensely by supplying a continuous heating furnace and an automatic rod reel.

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A FEW years later the question of a second continuous rod mill at Worcester was debated. **Mr. Morgan,** who had been greatly annoyed by maintenance problems on the **Bedson** mill, proposed a redesign. Roll scale continually washed down the spindles of the vertical rolls, right through the bearings and gears. If **Mr. Morgan** had been just a good mechanic he would have tackled the problem of sealing those vertical bearings, but being rather a man of ideas, he set all the rolls horizontal, and introduced twist guides to turn up the oval sections, thereby freezing continuous mill design for sixty years to come. **Mr. Morgan** soon left the **Washburn and Moen Mfg. Co.** and founded the engineering organization which bears his name, a name associated the world over with wire rods.

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WHILE **Mr. Morgan** and his associates were perfecting and refining the details of continuous

rolling, the Belgian mill was greatly improved, largely through the efforts of **Messrs. Garrett and Cromwell.** There was, for a time, a brisk competition between the two systems. Each borrowed freely from the other, **Morgan** breaking up the finishing train into sections connected by controlled loops, **Garrett** adopting the continuous roughing train, until just before the virtual disappearance of the Garrett mill it was hard for the layman to recite the differences. But **Morgan** stuck to small billets and strictly controlled loops, so that, however much the finishing mill might be opened up, the continuous principle, with its great advantage of uniform temper from end to end of the rod, was preserved.

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ANY assumption that the rod mill is to have a future other than the quiet refinement of details which has characterized its recent past, pre-supposes that there is something wrong with rods now. That's right, there is. Rod quality is now the number one bottleneck of the wire industry, a fact which has lately been emphasized by the cutting off of Swedish rods from our market. Let us consider, in order, what is wrong with our rods, what causes the trouble, and whether there is anything in history that points a way to a better future.

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WHAT we want in a rod is uniformity, roundness, accurate size, and, most of all, an unblemished surface. The first three we get in reasonable measure, in fact increasingly satisfactory measure; it's the surface that worries the wire mill. When the surface is poor, the blemishes may be attributed to two congenital weaknesses of the present mill, namely, twist guides, and wear of the grooves. Of the first there is little to be said. Ordinary delivery and receiving guides are emergency devices, theoretically needless, and making only casual, light, and intermittent contact with the rod, but the twist guide contacts every inch of the rod with a very considerable pressure. The scratches which it is certain to make at times are permanent blemishes.

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ROLL wear is fully as serious, indeed more so, since it affects roundness and accuracy as well as surface. Since all the grooves are wearing all the time, at differing and not exactly predictable rates, the man who tries to match intermediate sections to roll speeds is shooting at a target that is moving rapidly in all directions. A pass which requires, under a given set of conditions of temperature, relative size of roll and billet, and the like, a definite weight and shape of metal to exactly fill it, may get it for only a few seconds per shift. The rest of the time it is doing the best it can with an overfill or an underfill. Overfills run out into fins which fold in to make laps. Multiple stranding, a practical necessity in view of the investment and labor charge, intensifies this evil by making it impossible to close up a pass without affecting another pass which may not need closing, beside the obvious fact that no two passes can be exactly centered at once. These difficulties, upon which are superimposed those of changing relationships between roll and rod diameters, make awful tough going for the rod. It is miraculous that we do as well as we do. Nobody knows better than I how assiduously the sponsors of the continuous rod mill have labored to correct these faults, and in view of their successes it seems ungracious to refer to them, but the future can't wait much longer.

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AS a trouble-shooter I have learned a couple of valuable lessons. One is that when trouble has been localized in a detail, or an operation, before trying to improve it consider whether you can eliminate it. The other is when you are definitely lost, go back to the last fork in the road and take the other branch. In the light of history, what should we do about rod defects?

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WHEN **Charles Morgan** wrote **Mr. Bedson** that he proposed to introduce twist guides into the rod mill, **Mr. Bedson** protested vigorously. He said he had tried them, and they spoiled the rod. **Mr. Morgan** went ahead with his plans. He was justified in so doing by these circumstances. Wire was definitely on the way to big tonnage. The telegraph was already a large consumer, wire nails had made their appearance, construction was booming, the western prairies were rapidly being settled and planted. The wire fence was the only possible fence in a country devoid of stones and timber, and barbed wire was coming around the corner. Wire bale ties were being heard of. A new raw material, basic open-hearth steel, was coming into the wire field, a steel so mild and soft that scratches on the rod seemed to heal up in the die, square rods drew as readily as round rods, and no section from the rod mill was so wild and so shapeless that it wouldn't go to #8 telegraph wire in one draft. What was wanted was lots of output of something roughly resembling a round, and no breakdowns.

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THE common products are still with us, but they no longer set the pace, nor are they so common as they were in the days when the first half of a bundle made sixpenny nails and the last half eight-penny. And along about 1915 a change began creeping over the industry. While the causes of the gradual tightening up of rod and wire quality are hard to trace, I think **Henry Ford** had much to do with them. When his alloy steels were scratched in the guides the scratches didn't heal up. In a very brief time, the rod mills were getting quality-conscious, and things have been getting tougher for them ever since. Considerable improvement has been made in mill details, and the operators have done wonders with the tools they have, but it is clear that all hands are working themselves into a lather putting poultices on a cancer which only the knife can cure.

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THE **Bedson** mill made no guide scratches because it had no twist guides. Its weakness, scale in the bearings, was a fault not of

the designer but of the times. Vertical rolls are now a commonplace; why not go back to them, with sealed anti-friction bearings? We escape guide troubles, and troubles due to multi-stranding. We might well make all the stands 45° to the floor line, so that the alternate stands, right and left hand, would be duplicates. Individual motor drive would be a logical step, and since there would be only one pass in each stand, which could be close to the bearing, overhung rolls, simple narrow-faced discs, would certainly be handy to tend, and easy to change. Both these features, alternate 90° stands and overhung disc rolls, have been used successfully in Europe for several years. Such a roll stand, with all the implications inherent in the idea, might look somewhat like this rough sketch, which should be charitably received by the reader until I have had a chance to support it in later paragraphs.

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NOW we have fixed up guide scratches by eliminating guides, what shall we do about the more serious evil, wear in the grooves? How about eliminating it? If we are to have disc rolls with single grooves perhaps we could spend money enough to get a more durable material. Would money buy anything better than we are now using? We now use chilled cast iron and alloy steel. This has a familiar ring to a wire man's ears—we used to use those exact materials to resist the same sort of abrasion as dies. We switched to tungsten carbide, and increased our die life in the ratio of 3000 to 1. How about tungsten carbide rolls?

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ROLLS of orthodox size and shape could not be provided at this time at any price, but how about a disc, bolted to the end of a spindle, or perhaps a carbide rim shrunk or keyed onto a steel disc, or perhaps a carbide insert in the face of a steel disc? Such pieces can be had now, at reasonable prices. If carbide rolls out-lasted chilled iron and steel in the ratio that carbide dies out-last the same die materials, a finishing groove which now lasts eight hours, would last three years. This of course sounds ridiculous. But let's assume that we will permit not the rather generous wear now tolerated in rolls, but a wear of less than .001", and let's say that this knocks 90% off our life; we still have four months. Let us further assume that for some reason not comprehensible, since the service is closely comparable, our carbide rolls do only one tenth as well as do

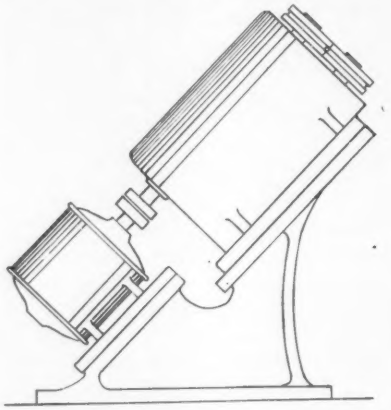

Fig. 4. Proposed roll stand. ✦ ✦

our carbide dies. We still have a life of ten days!

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THIS is a stimulating thought, not that we begrudge a roll change in such a simple stand, but because of the implications. It simply means that passes can be designed for ideal reductions and will stay as they start, for periods of time which, compared with today's practice, seem like geological eras. This in turn means a virtual end to compromises, and an end to overfills and underfills; each pass will receive exactly the metal required to fill it, and will hand along to the next rolls precisely the section best designed to feed them.

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OTHER implications arise, in truly bewildering number, each leading to others. I can now defend the odd and over-simplified roll stand of my sketch. An orthodox mill has rolls which are adjustable in two planes for wear and maladjustment, and in consequence require something of the nature of universal joints, as provided by spindles and couplings between rolls and gears. Non-wearing, non-adjusted rolls with accurately ground grooves could be mounted on geared spindles, and the entire outfit designed as a machine tool. It is in fact a precision tool, and appropriately enough is tooled up in the modern way with tungsten carbide.

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HERE is another random thought. We start roughing down a billet with 35% reductions, and wind up 12 to 15%. Our six roughing stands do more work than ten finishing stands. The ratio between roll size and billet size at starting is about 7 to 1, and at finishing, about 50 to 1. Large rolls spread instead of elongating the rod, and much time and power and wear is expended in vainly pushing metal back and forth. In orthodox construction we cannot get much under a 9" finishing roll, for reasons clearly apparent but too involved for brief discussion, but carbide rolls could probably come down to four or five inches. Theoretically a rod could be finished in ten passes, actually perhaps in twelve, with appropriate roll diameters.

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IN the absence of twist guides the spacing of stands could be readjusted, and there is the interesting possibility that the leader could hold up a fat oval which the finisher could put into a practically perfect round.

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THIS, then, is my prediction for the future of the rod mill. We shall stop fiddling with palliatives, and simply eliminate those details of practice and equipment from which our rod troubles arise. Given a sound billet, the rod mill of the future will deliver an unblemished rod more accurate in size and section than was the drawn wire of a very few years ago. I can think of nothing that would give the wire industry a bigger lift than a thoroughly good wire rod. The demand is right here, and right now.

Cleaning

IN the beginning wire rods and annealed wire were freed from scale by rubbing them with stones, bricks, and sand. This work was reserved for children and old folks, probably cost nothing, and persisted unchanged for about 500 years. This hand cleaning was very slowly superseded by "thrashing" in the forms which may still be seen in some specialty mills, by cracking off the scale in roller or pin straighteners, and by tumbling in a barrel with water and sand.

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THE notion of pickling off the scale did not come as a flash of inspiration to some advanced thinker; it simply lay in the back of everyone's consciousness as something that would be desirable if only acids were cheap enough and lively enough. Fully a century before any regular use of acid we hear of soaking wire in various waste products containing organic acids. Liquors from the distillation of wood, fermented rye meal, brewer's wastes, tartar from wine vats, these and similar mixtures appear in the records, particularly in connection with the cleaning of fine wire that had been annealed in closed vessels. Unfortunately these baths were very slow, often taking a month to do their job, and were more apt to soften than to actually remove scale. A long soak in one of these liquors followed by hand thrashing gave a nice surface.

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EIGHTY years ago the tumbling barrel was the last word in rod cleaning. Sulphuric and muriatic acids were well known, in fact sulphuric had been in use for pickling sheet iron since 1806, but they were too costly for the wire mill. In the decade 1855-1865, which brought changes to every detail of wire practise, acid cleaning came in with a rush. As usual it was brought in by a combination of circumstances, the most potent of which was pressure from telegraph companies. Coarse wire was wanted, for the first time, in long pieces. This implied heavier rod bundles, and it can be readily imagined that while 10 lb. rod bundles would tumble nicely, 50 lb. bundles would tangle.

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IT is likely that this alone might have forced the use of acid, but luckily there came at the opportune time an increase in acid production and a reduction in the cost. In 1853 sulphuric acid was used for pickling rods in Belgium. In 1854 **Mr. Washburn's** Quinsigamond wire mill brought 6000 lbs. of "vitriol." In 1863 **Mr. Washburn** described his pickling practice to **Mr. Bedson,** who replied that it was interesting but would never be adopted in England because of the high cost of sulphuric acid. **Mr. Nehemiah Highley,** whose early days were passed in the wire mill at **Tintern Abbey** in Wales, says that about 1867 their rods were partly pickled and partly tumbled. In the background are these facts; about 1853 the Belgians began to recover sulphuric acid as a by-product from certain chemical operations, and about the same time there began in our country the smelting of sulphide ores from the Rocky Mountain area, with recovery of acid from the sulphurous fumes.

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THERE was no further change in pickling until the advent of the inhibitors. I do not know just when or how this boon to humanity crept into use, and would be glad to hear from some of the old-timers on the point. I vaguely recall the use of red-dog flour before the World War, but did not hear it discussed. Sulphuric acid in the war years went largely into the manufacture of explosives, and came back to the wire mill in the form of nitre cake and similar by-products containing nitrogenous impurities. These had a good deal of merit; they gave us a pre-view and softened us up for the inhibitor salesman.

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INHIBITORS were important in the history of cleaning, not for the acid they saved so much as for the way they and their associated foam blankets made the cleaning house a place where self-respecting men could live and work, and see what was going on. Following their use there was a notable reduction in dirty wire and a general rise in standards.

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ACID pickling has always had its competitors, but none of them seems a serious threat. Sand blasting and other forms of abrasive cleaning appear periodically, but never quite make the grade. Various forms of electrolytic cleaning have their small fields which they constantly hope to enlarge. The reduction of scale to metallic iron in place is entirely feasible, but has not yet proved practical. Scale can be cracked off by rolls or pins, and the resulting rod may pick up a soap coat and draw quite satisfactorily. A new process now being mentioned coats the wire with a film of glass which, when it cracks off, brings the scale with it. Most of these processes suffer the disadvantage that they call for strand treatment, and the mere uncoiling and re-coiling of wire, regardless of intermediate steps, costs more than complete acid pickling. Even batch treatment consists so largely of picking up and setting down yokes that the cost of the actual cleaning medium does not dominate the situation. I predict for acid pickling a long life and little change.

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The Sull Coat

THE sull coat is one of the few details whose history is clear and definite. Its origin is intensely interesting, though perhaps a bit tricky to explain in polite society; the sort of story that runs to rows of asterisks, quotation marks and foreign phrases. I shall do what I can with it.

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UP to 1650 all wire was wrought iron. Much of it was used where we now use high carbon, as for brushes, cards, fish-hooks, and the like. High carbon steel was available, and its value in such products was clearly foreseen, but it simply would not draw. Fre-

quent efforts were made to start high carbon rods, with everything available in the way of dies and lubricants, but with no vestige of success. One wire drawer in **Altena, Germany,** after one of these discouraging experiments, threw the rods out behind the mill into a small enclosure which might be loosely described as the "gents' rest room," or, in the stately language of the latin text, "where men went to cast their water." Some time later, on picking up the rods, he found them coated with a soft brownish scum which felt slippery. In an inspired moment he tried them in the die without recleaning, and they drew! Thus sull coating was born, in a privy.

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THIS secret was kept right in **Altena** for many decades, and Altena built up a nice monopoly. The rods, dry-cleaned with bricks and sand, were sulled in the manner described. A contemporary writer speaks of the wives and children going to the mills at noon with shoulder yokes, from one end of which hung the dinner pail, and from the other a familiar household utensil not often named, containing the raw material of the sull coat. After about 100 years someone found that dilute sour beer had the same effect. Another century passed, and it was discovered that plain water would make a sull coat.

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AS long as we clean by wet processes our wire will pick up a sull coat instantly, automatically, and inevitably, and our only choice will be between degrees of sull. If we go to a dry cleaning process we may have to work out some new way to sull, but I predict with confidence that we shall not go back to the Altena technique.

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The Lime Coat

LIME was used in a tentative way many decades before it became an established coating. Some of the eighteenth century writers mention that if the rods are immersed for some days in lime water they seem to draw more easily. I believe lime really came in as a definite part of the process at about the time acid pickling got its foothold, in that magic decade 1855-1865. **Mr. Highley** found it in use at **Tintern Abbey** about 1865 on both pickled and tumbled rods.

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I BELIEVE it may have been slow creeping into American practice. **Jack Mordica** has told me of the hellish time he had at **Oliver and Roberts**, changing over to the lime coat. **Clem MacGowan** remembers when rods were lime-coated by splashing from buckets. I myself remember when the old flour coat was in quite extended use in specialties, although the lime coat was fast driving it out. The **Quinsigamond** mill bought 36 casks of lime in 1854, but for what purpose, we do not know. My guess is that we clung to the flour coat long after England had gone onto lime. I should be glad to hear more on the subject.

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LIME is cheap, effective, and plentiful. It is threatened from time to time by various other alkaline salts, phosphates, soda ash, and the like, but it is serving us well and I predict for it a long life.

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Baking

THERE was no thought of drying or baking rods until wet cleaning processes were established. Even then it was a most perfunctory operation. **Mr. Highley** says that at **Tintern Abbey** the bundles, 12 to 14 pounds each, were dipped in lime and hung up on pegs to dry in the sun and wind. On rainy days they were hung on a bar in front of an open fire in the mill. These were the days of wrought iron, which did not rust readily, nor yield to acid brittleness. Baking probably became more formal with the advent of bessemer steel, in the 1860's. We started with crude brick chambers heated by open fires and salamanders, with rods hung on the walls and racked against the walls and on the floor. We progressed to trucks, we put the fire outside and led flues through the baker, we laid down tracks, we increased the temperature, we sloped the tracks, divided the baker with partitions and put doors at both ends. We defined a path for the warm air by admitting it near the flues and providing escape vents in the roof. Finally we heated the air in a separate chamber and forced it through the rods by fans.

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SINCE each increase in temperature and air velocity effected a drop in baking time, the flash baker now in extended use, though a long step ahead, was a logical step. Flash baking has cut fuel cost tremendously, and merged baking labor indistinguishably with cleaning labor. The operation is now, in fact, a mere detail in the cleaning operation.

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Copper Coatings

FOR the sake of the record I should like to set down here two stories relating to the origin of metallic drawing coats on steel wire. Up to perhaps 80 years ago wet drawing was done on the bare iron surface. At an English mill where both steel and brass were handled, and where there were acid baths to be heated and brass ingots to be quenched from the mold, some frugal soul thought of combining these chores by dunking hot brass ingots in the acid tubs. The resulting copper deposit on the steel wire was immediately appreciated and adopted as standard.

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THE other yarn relates to the tin-copper coat, and is told of the mills of my home town, Worcester, Mass. A coppering tub was lead-lined to prolong its life, and it soon became noticeable that wire coppered in that tub showed very attractive straw and golden shades. During the ensuing investigation the lining collapsed, and it transpired that the copper sulphate had eaten the tin out of the soldered joints. Thus a new finish was born.

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The Die

APPROACHING the die, the historian finds himself on thin ice. The history of the die is the

history of wire drawing, and there is mighty little about it that can be proven. It is pretty well established, however, that the first written reference to the die is that in the *Theophilus* manuscript, which is of a date near 1000 A.D. I have plowed through this entire medieval latin text in search of clues. I don't know whether there are any translations, but at any rate I got my information the hard way. Dies are casually mentioned as tools likely to be found in any properly equipped metal-worker's shop. Other references in the book make me suspect that wire drawing was fairly new, and that it may have grown out of the practise of pulling soft-metal wires through tapered holes burned in hard oak blocks for the purpose of smoothing out hammer marks. We know that clipping strips off sheet metal and rounding them with the hammer was the ancient method of producing wire, and we know that these crude wires were polished as described. I think the technicians were very close to wire drawing several centuries before they noticed that a little overpolishing would elongate the wire.

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A CONTRARY view is supported by the existence of two iron dies, one found among **Viking** relics dated about 700, and one found in France and believed to be of about the year 400. They certainly look like dies, but they remind me of my stone die which was found 100 years ago in an Indian burial mound near Spencer, Mass. I cruised around in museums of American Ethnology until I found many similar dies from all parts of North America. Some of them showed, around the holes, a peculiar high glaze which I had already noted on scrapers used in preparing deer hides, doubtless the result of attack by some acid in the leather. This made it pretty clear that these "dies" were used to round up strips of raw hide sheared from the skins and used for sewing. These Swedish and French relics may have served a similar purpose.

✦ ✦ ✦

THERE was, for several centuries, a close relation between wire drawing and the manufacture of chain armor. The two industries were centered in the same small district of central Europe, and for several centuries after the decline of chain armor the wire mills put out a line of small wire goods, hooks, rings, rivets and the like, under the name "armor goods." Many investigators believe the relationship to have been so intimate as to constitute absolute dependency, and therefore date the rise of wire drawing back to the first appearance of chain armor. With this view, I cannot agree. After examination of many specimens of chain armor, I am unable to find any reliable evidence that drawn wire was used. If it was used, the subsequent operations of bending, flattening, dishing, weaving, piercing, riveting, and heat treating, would effectually destroy such evidence. Moreover, these operations themselves were so difficult and costly that any saving due to the availability of drawn rather than hammered wire would be insignificant. The two industries were undoubtedly closely related for several centuries but neither was essential to the other. I believe that chain armor was made before wire was ever drawn through a die, and that it would have continued to be made if wire drawing had never been invented.

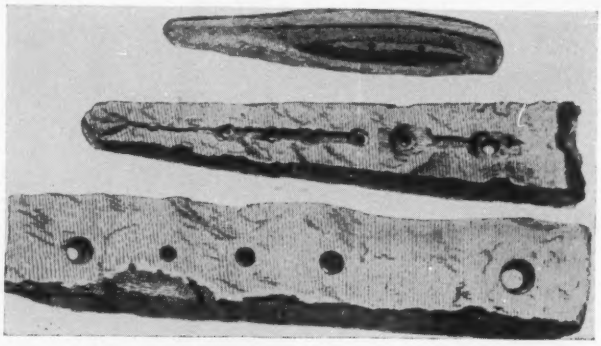

Fig. 5. Relics from France, about 400 A.D.

✦ ✦ ✦

Fig. 6. Stone die found with tools of the American Indians about 1840.

✦ ✦ ✦

THE early dies must have been iron, possibly hardened by cementation. History is silent up to about 150 years ago, at which time there was published a rather complete account of their preparation. Pot metal was cracked up, melted, cast on an iron plate, cracked, remelted, and so on through many cycles. It is fair to assume that it started as cast iron, and gradually lost carbon and silicon through repeated melts until it approached that vague boundary between white cast iron and hyper - euctectoid steel. Then a wrought iron plate was prepared, by deeply scoring one face. The crushed pot metal was heaped on this plate and bound round with cheesecloth and fire-clay. The packet was heated very hot and lightly hammered, reheated, hammered, and so on. The high carbon material would become pasty and gradually diffuse into the iron plate until the whole billet was one solid piece. This was then pricked with holes, and became what we recognize as a wire drawing plate of the old German type, peppered with holes of so many sizes that one die would set up a wire drawer for years of work.

✦ ✦ ✦

THE English developed the die in another direction; they cast and forged high carbon steel into the familiar "wortles." Chilled cast iron as a die material seems to have been an American innovation, and it had not spread very far when tungsten carbide swept away all competitors.

✦ ✦ ✦

WHEN the microscope poked its intrusive nose into metallurgy, it should have been possible to predict a speedy revolution in dies. The structure of a good die was seen to be cementite, iron car-

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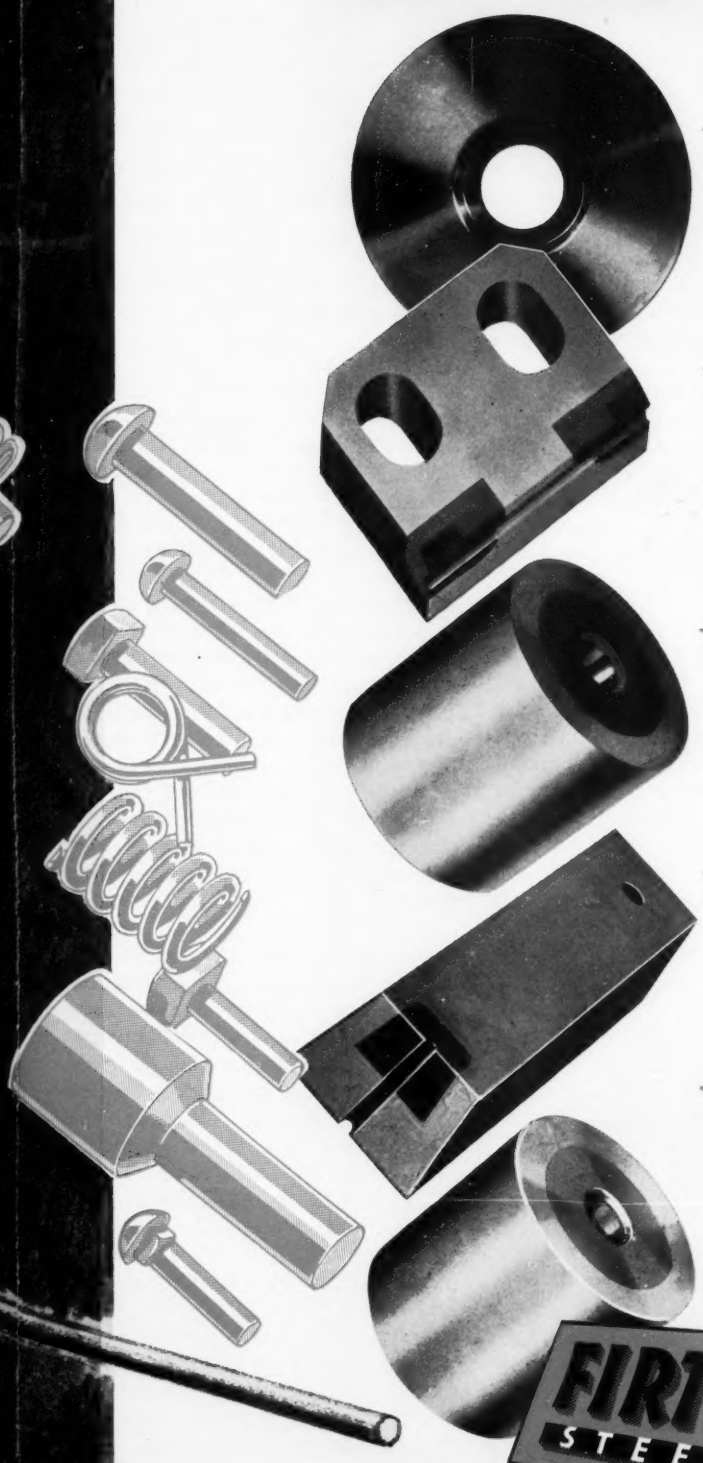
NOW, ONLY MAXIMUM PRODUCTION IS GOOD ENOUGH!

A decade ago FIRTHALOY Sintered Carbide Wire Dies revolutionized wire drawing practices. They made possible the uninterrupted production of wire in terms of *miles* and *tons* and *days* instead of in feet or pounds or hours. As they have created new conceptions of production, so are FIRTHALOY Dies for Cold Heading, Extruding, and other wire *deforming* operations, setting new production highs. When only MAXIMUM production will do, FIRTHALOY Dies will do it!

FIRTH-STERLING
FIRTHALOY
QUALITY

FIRTHALOY DIES

MEET THE EMERGENCY!



★DRAWING DIES

Now, and until some new method is evolved, FIRTHALOY Draw Dies will draw more wire, at higher speed, to closer tolerance, with better finish, and at lower cost than any others. Until you use FIRTHALOY you are not getting *maximum* production. Fully 75% of the nation's wire mills have proved this fact!

★SPRING FORMING DIES

Years ago nationally known manufacturers of Spring Forming Equipment chose Firthaloy for Arbors, Coiling Points, Pitch Tools, Loopers, Cutters, Roll Guides, Knotter Gears, etc., as the only fully effective material for automatic production of springs. Today, "all out" production of springs for vital war materials demands full adoption of FIRTHALOY.

★COLD HEADING DIES

The minutely accurate tolerances, that are absolutely essential in the production of aircraft rivets and other cold-headed parts, are maintained in continuous production for long periods with FIRTHALOY Cold Heading Dies. Additionally, better finish, faster machine operation and lower die cost result.

★NAIL MAKING DIES

The increasing demand for nails in war-time building projects will necessitate greatly expanded nail production. FIRTHALOY Nail Dies bid fair to revolutionize nail production in the same manner that Firthaloy Dies overcame similar wire drawing problems.

★EXTRUDING DIES

To the hundreds of vital extruding operations involved in present manufacturing, FIRTHALOY Dies bring new conceptions of automatic production. FIRTHALOY'S remarkable resistance to wear is responsible for its adaptability for critical extrusion jobs.

FIRTH-STERLING STEEL COMPANY

OFFICE AND WORKS: McKEESPORT, PA.

BRANCH WAREHOUSES:
NEW YORK CHICAGO
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CLEVELAND DETROIT

bide, with or without carbides of chromium or tungsten, depending on the chemistry, the cementite being supported in a matrix of pearlite in which spheroidization had gone so far as to leave practically a matrix of Alpha iron. Carbides were the working portion of the structure. It was a mere step to that denser massing of carbide of tungsten in a matrix of cobalt which is the carbide die of today. This has been one of the quickest and most thorough of wire mill revolutions. The ten years from 1926 to 1936 cover it rather completely.

✦ ✦ ✦

AS to the future of the die, I refuse to stick out my neck. The making and preparation of dies used to belong to the wire drawer; it passed into the hands of the management, and now belongs to specialists from outside the organization—Let them make the predictions.

✦ ✦ ✦

Lubricants

IT has been said of **Christopher Columbus** that when he set forth on his famous voyage of discovery, he did not know where he was going, when he arrived he didn't know where he was, and when he got back he didn't know where he had been. Nothing could better describe the situation in wire drawing lubricants, whose history was never noted down, whose present is confused, and whose future is enshrouded in fog. So far as the past is concerned, we labor under the disadvantage that wire makers rarely discussed their business in public, and what little has leaked down to us comes through the hands of casual observers who easily missed small but important details. Until 1540 there is no mention of the subject. At that time it is said that bees'-wax is good for gold wire, because it gives it a good color. Later references, all brief and casual, treat lubrication as though it were optional, a sort of fancy touch. Circumstantial evidence indicates that it was vital. Some of the early drawings show, threaded onto the wire at the die, what looks like a small leather bag which probably held the grease or soap. Altena, in its hey-day as the home of high carbon wire, consumed enormous quantities of olive oil, and we can guess that it went into olive-oil soap.

Fig. 7. Wire Drawing about 1400. ✦

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THE typical European wire drawing practice, now dying out, involved true lubrication, with scores of oils, plain, blended, and sulphonated, mixed with by-products of fermentation processes, copper sulphate, and chemicals too numerous to mention. **Bonzel** has an excellent chapter on the subject, with discussions of the curious film that is believed to exist as a separate entity upon the surface of the wire as a result of chemical union of parts of the iron molecule with parts of the lubricant molecule, and to partake of the natures of both.

Fig. 8. Fine wire, about 1527. ✦ ✦

✦ ✦ ✦

THIS is all of great interest, but to us of academic interest only. We are committed to dry drawing, and our operation responds to the laws of unlubricated friction. Our soap is in no sense a lubricant. It simply keys to the lime, which keys to the sull coat, which is anchored to the steel, the whole forming a non-metallic sleeve which we draw, and whose core, the wire, comes along with the sleeve, just as the steel core in a copper-clad wire.

✦ ✦ ✦

HERE is a process, called lubrication, whose past is unknown, whose present is misunderstood, and which is going under a false name. Who could foretell its future?

✦ ✦ ✦

Wire Drawing

AMONG the oldest wire drawing pictures those shown here, from the fifteenth century, show clearly all there is to know. They bring out the facts that rod drawing was no job for a weakling, and that fine wire was drawn on blocks from very early times. I hope nobody is misled by the clerical garb. Wire drawers of the time were probably no saintlier than their successors. The fact is that we are getting a look at industry in the Dark Ages. Europe was in a cultural eclipse; society and authority had collapsed, men had reverted almost to savagery, crouching like animals in rude huts and living on roots, berries and small game. Only in the monasteries was there organization, authority, culture, and security, and to the monasteries flocked all who had special skills and aptitudes for which no other market existed. Those few who could read and write were employed in recording all that was known which was in danger of being forgotten during this eclipse of civilization. It was probably under such circumstances that Theophilus wrote

his book of technical instruction. These wire drawers were probably lay brothers, doing whatever they knew how for room and board. I have often suspected that the great revival of cathedral building during these centuries represented less a religious renaissance than an effort on the part of the Church to relieve unemployment and get some return for board and lodging.

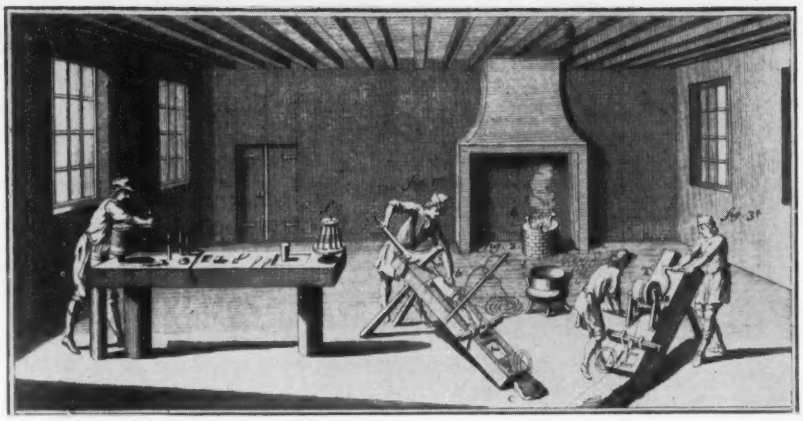

Fig. 9. Fully integrated mill, 1720.

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THE next picture, apparently a complete mill in about 1720, hints at several changes. Rods are smaller and longer, and can be drawn by hand through a slight leverage, with tongs that slide back and grip again without attention. Another picture of 1780 shows the job fully mechanized, with a water wheel doing the heavy work. The mill operated secretly about 1350 by the famous **"Rudolph of Nuremberg,"** believed to have been the first to make use of water power, was described in full detail by **Eobanus Hessus** in 1500 and had precisely the details of this illustration. I have heard discouraged salesmen complain that our wire mills clung too long to old designs, but at least our cycles are shorter than four centuries. Note the man in the background rubbing the scale off wire with a gritty rag. A keen eye can distinguish a little bag of lubricant at each die.

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IT is difficult to believe, when looking at this mill of 1780, that **Fleuer** had introduced rotating rod blocks in 1728. It would appear that he was born too soon. It is probable that rods could not be produced consistently in sufficient lengths to warrant breaking down in coil form, and that the practice faded out, to return only with an insistent demand for coarse wire in long pieces. At any rate **Fleuer's** record disposes of the claims of various districts and individuals to have "invented" the rod block at later dates. Even **Ichabod Washburn,** the dean of American wire masters, believed, when he began to use it about 1850, that he was pioneering. It is one of the very few things he mentions with pride in his autobiography.

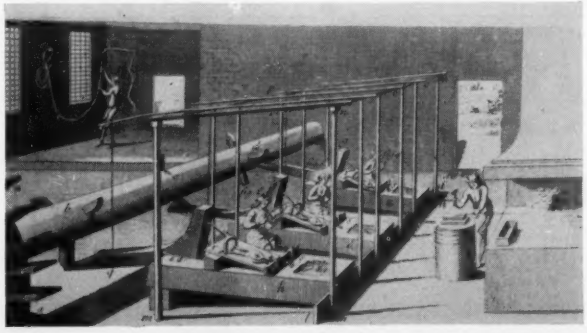

Fig. 10. Power driven mill, 1780.

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TAKING the broad view, wire drawing remains absolutely unchanged after 1000 years. The devices through which power is applied to the wire have been refined from time to time, but only as the wire mills shared the general advance in technology. It is difficult to name a single change in wire drawing that arose within the industry and was applicable only to the industry. A possible exception is the **Connor** principle of withdrawing wire axially to facilitate continuous drawing, which certainly arose in the wire mill and is applicable to no product other than wire. But the fact is that wire may be drawn through a die by hand, by a team of horses, by an elephant, or by a Ford tractor, and the product will exhibit the same properties as though it had been sanctified by contact with some thousands of dollars worth of electrical refinements.

✦ ✦ ✦

WITH its past and present thus virtually telescoped, it would be hard indeed to plot a future for wire drawing, were it not that the future has already been revealed to us. The wire industry has been offered a preview of the future and has turned its back on it. I refer to reactive drawing, which has been freely discussed in the columns of **Wire & Wire Products.** For a thousand years we have been simply pulling on one end of the wire; now we are asked to pull on both ends at once, with the promise of power saving, increased die life, reduction of friction, improvement of surface, and a more flexible control of physical properties.

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NOT that I blame the industry for turning its back. The whole thing sounds ridiculous, and to secure a real firm grasp on its fundamentals calls for a greater amount of study and concentration than the average wire executive wants to risk, especially in these times. But our future is wrapped up in these formulas and equations, and some day they must be faced. Knowing that the principles involved are hard to grasp (*Please turn to Page 56*)

SLEEPER & HARTLEY, Inc.

DESIGNERS AND BUILDERS
of AUTOMATIC WIRE-WORKING MACHINERY
AND WIRE MILL EQUIPMENT
WORCESTER, MASSACHUSETTS, U. S. A.

General Bulletin *(See Note Below)* *June, 1941*

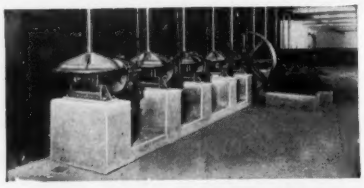
WIRE MILL EQUIPMENT - See Bulletin No. 108

WE ARE PREPARED to furnish the latest and most improved types of Wire Mill Equipment covering Cleaning and Dry Houses, Cranes, Patenting Furnaces and Patenting Furnace Take-Ups, Tinning and Galvanizing Equipment, Rolling Mill Equipment for rolling special shapes, as well as a complete line of single hole and continuous Wire Drawing Equipment for both low and high carbon wire.

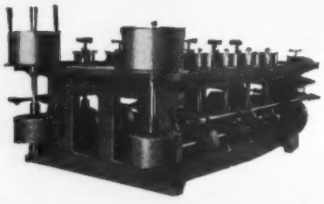
10-BLOCK ROD FRAME
(Improved)

First Floor View

Embodies the latest and most improved practice. Long, stiff, vertical Block Spindles, each equipped with powerful friction clutches, and running in anti-friction bearings provide smooth running and practically noiseless operation. This improved 10-Block Rod Frame will reduce costs over any Single Block Frame now offered.



Basement View

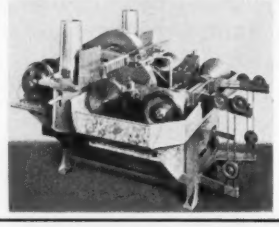


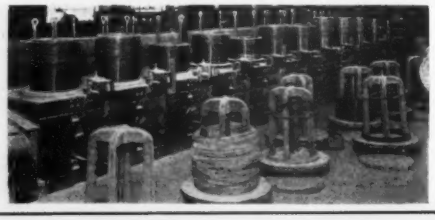
DOUBLE 5 or 6 DRAFT DRY INTERMEDIATE

These machines employ C. I. frames, table, girts, etc. Bronze replaceable drums. 16″ Blocks, cut gears. Drives are made to suit customers requirements.

DOUBLE 6-8 or 10 DRAFT CONE TYPE WET

These machines have proven very satisfactory for basic and High Carbon Wires. C. I. frames, table, girts, etc. Steel replaceable plate drums, 8″ blocks, cut gears. Direct motor drive or pulley drive to suit.

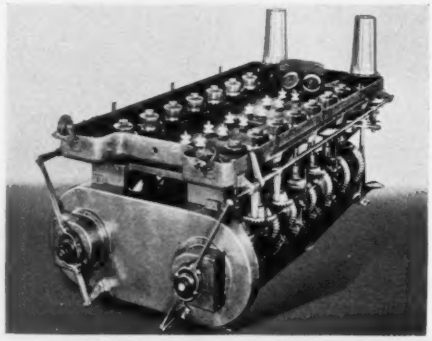




EXTRA HEAVY 15 FRAME for Basic or High Carbon Wire with cut gears and steel frame drive to suit, and double-deck blocks where required.

DOUBLE 8 DRAFT FINE WIRE PAN TYPE WET

These machines have met with the approval of fine wire operators throughout the country. Replaceable steel or bronze drums, 8″ blocks, pulley or motor drive to suit.



Note:—*This is page 4 of our new 4-Page General Bulletin. Your copy is ready.*

Continuous Process For Rubber Insulating Wire

By J. Z. Linsenmeyer,
Industry Engineering,
Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

Describing a novel arrangement made possible by the use of a Westinghouse "synchro-tie" drive along with new and improved continuous wire insulating machinery for a continuous process for rubber insulating wire. ✦ ✦ ✦ ✦

AT this time when so much is heard concerning increased production, it is interesting to learn of some of the developments which are working so effectively in accelerating our production schedules. While speeding up production one should not lose sight of the fact that the quality of the product must be maintained. The aim, then, in adding new equipment, should be twofold—the new and improved machinery should provide not only an accelerated but also a more highly controllable process. It was to this end that the engineers of the **National Electric Products Corporation** were working when they installed at their Ambridge, Pa., plant three complete continuous wire insulating machines as developed and manufactured by the **National Rubber Machinery Company** at Akron, Ohio.

✦ ✦ ✦

IN most plants that have been in operation for some time space is at a premium and is quite often the limiting factor in considering the installation of new equipment. In this respect the Ambridge (Pa.) plant of the **National Electric Products Corporation** was no exception. However, the use of a **Westinghouse** "synchro-tie" drive along with the new and improved continuous wire insulating machinery made possible a novel arrangement which required only minor changes in plant layout to utilize previously wasted space.

✦ ✦ ✦

SINCE the development of the continuous wire insulating process several years back, manufacturers of rubber covered wire are rapidly replacing their older and less efficient methods of insulating the smaller sizes of wire. The older processes of manufacture include numerous unconnected operations involving the relatively slow coiling of the covered wire in pans of soapstone, an operation which fills the surrounding air with talc dust which later settles on the floor and on the equipment, resulting in unfavorable working conditions and increased machinery maintenance; the handling to and from open steam vulcanizers and the final winding of the wire on reels. The new continuous process includes the various disconnected operations of the old methods, but combines and arranges them in a continuous sequence of operations from the automatic feeding of rubber strips into the extruder to the reeling of the insulated wire.

✦ ✦ ✦

Sequence of Operation

THE uncovered wire from the supply reels passes through the die head on the tuber where the insulating rubber covering is applied. The wire then continues through a vulcanizing chamber 175 feet long, and during the passage through this chamber the rubber insulating covering is completely cured. Figure 1 shows the first

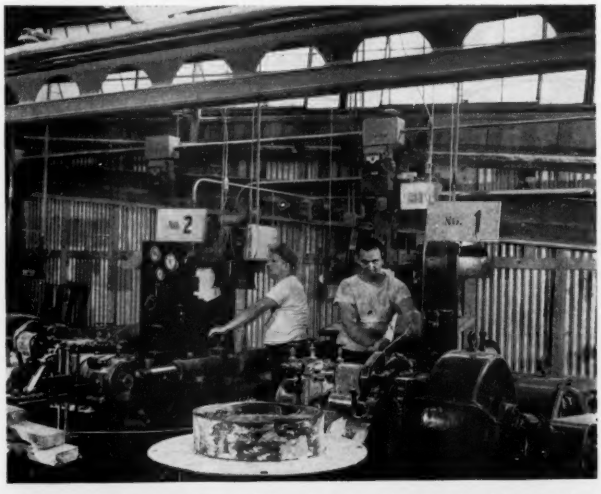


Figure 1. Starting of the Insulating Process. Here the insulating rubber is being fed into the three tubers, and the bare wire is being pulled through the die heads on the tubers, where the extruded rubber coating is applied, and thence through the vulcanizing chambers. ✦ ✦

Figure 2. The wire with its rubber insulation now completely cured exits from the vulcanizing chambers and passes through the high voltage test, the cooling chamber, the talc box and thence to the wind-up reel. ✦

step in the processing. The three tubers may be observed in the background, and at the left of the No. 1 machine the reel of bare wire may be seen as it enters the tuber. The roll of strip rubber insulation is being fed from the round flat table into the extruder. The feeding of the rubber into the extruder is carried out automatically—the rubber strip being pulled from the table by a spiked roller on the extruder. The beginning of the vulcanizing chamber of the No. 2 machine is seen starting from the head of the tuber. The operator of the No. 2 machine is speaking into the loud speaker which is the only means of communication with the operators at the take-up mechanism. It seems rather amusing that here are two men working together every day on the same machine—one working at the start of the wire processing and the other working at end or take-up mechanism — and they may never have seen each other. However, the author was assured that they had met and been properly introduced.

✦ ✦ ✦

PASSING from the vulcanizing chamber the wire is carried through a high voltage insulation tester where any insulation weakness is immediately detected, and when such weaknesses show up a warning signal is given and a register makes a permanent record. In this manner the faulty wire is quickly spotted and that reel of wire is then put to the side for future inspection and correction. From the insulating test the wire continues through a water spray and bath for cooling purposes and then through a talc dusting box in which revolving brushes remove the excess. Following which the finished wire is wound on reels. Figure 2 shows the wire entering the high voltage insulation tester in the foreground, then the compartment housing the haul-off capstans, water spray and bath followed by the talc dusting box and the take-up reels.

✦ ✦ ✦

DUAL supply and take-up reels for each unit eliminate any necessity for stopping the machine at the time of reel change. As one reel becomes full the second reel is readily connected to the line-shaft and the wire is then cut and led around the second reel without interruption to production. The full reel is then removed and an empty reel replaces it. Figure 3 shows the dual take-up reels.

✦ ✦ ✦

Motor Driving Units

THE tuber or rubber extruder is driven by a 25-horsepower d-c motor having adjustable field control which provides for operating over a 3 to 1 speed range. Power for the reel end is transmitted electrically from the tuber motor by means of a Westinghouse "synchro-tie" drive which consists of a transmitter at the tuber end and a second unit at the reels. The transmitter is driven from the tuber through a PIV variable speed device. Figure 4 shows the 25-horsepower direct current motor connected to the tuber through a "V" belt drive. The transmitter unit of the "synchro-tie" may be seen extending out from under the guard housing of the belt drive. Located 175 feet away from the transmitter is the second unit (the receiver) of the "synchro-tie" which drives the take-up end in synchronism with the tuber.

✦ ✦ ✦

THE rate at which the insulating rubber is extruded is adjusted by the speed of the d-c tuber motor. The speed at which the wire is pulled from the vulcanizer is determined by the speed of the "synchro-tie" unit which is directly synchronized with the speed of the tuber, but which can be adjusted over a little better than a 3 to 1 speed range with respect to the main tuber drive by means of the PIV adjustable speed unit which has its input shaft direct coupled to the tuber, and its output or low speed shaft coupled to the transmitter of the "synchro-tie" system. The speed of the receiver unit of the "synchro-tie" is determined by the speed of the transmitter, and it will operate exactly at the same speed as that at which the transmitter is driven. In this manner the reel take-up mechanism and the pulling force exerted on the wire are synchron-

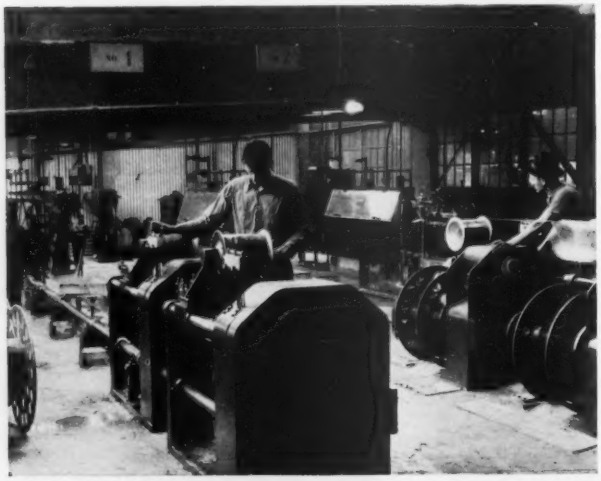


Figure 3. Dual Take-up Reels provide for ready transfer of the wire from a full to an empty reel without interruption to the continuous processing.

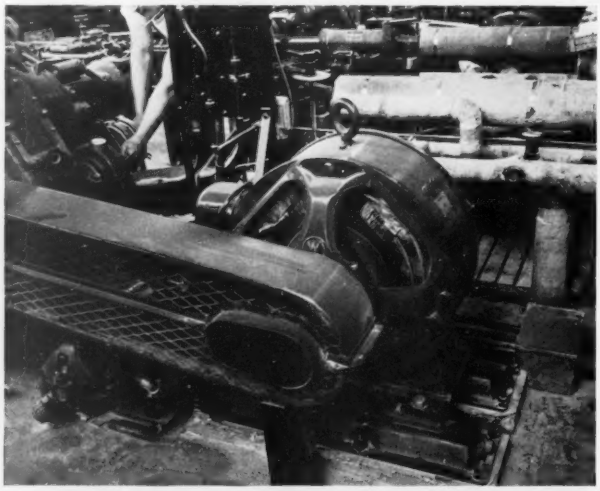


Figure 4. Direct Current Adjustable Speed Motor driving tuber. ✦

ized with the tuber so that undue tension is not placed on the wire—which is of considerable importance in producing a uniform coating of extruded insulating rubber.

✦ ✦ ✦

IT might be said that the "synchro-tie" is the big lineshaft that isn't there, for essentially such is its function. A lineshaft 175 feet long geared at one end to the tuber and at the other end to the capstan and take-up reels would perform exactly the same function as the "synchro-tie" system under production operation. However, it would be most difficult to install such a long lineshaft in an overhead location as was here required in order to capitalize on unused space. Also, a lineshaft of course could not provide for independent operation of the take-up mechanism as may be desirable at the end of a run when it is necessary to pull the end of the wire through the machine. Therefore, besides saving space and eliminating a long drive shaft the "synchro-tie" has the additional advantage of providing for independent operation of the receiver end.

✦ ✦ ✦

THE "synchro-tie" unit consists of two identical motors, which but for minor design modifications are standard wound rotor type induction motors, tied together electrically in such a manner that when either one of the units is turned over by some driving force it will transmit torque to the second unit (the receiver) which will then operate in synchronism with the transmitting unit. When not connected for "synchro-tie" operation either machine may be operated independently in the same manner and with the same operating characteristics as a standard wound rotor induction motor. Figure 5 shows a close-up of the "synchro-tie" receiver unit. It will be noted that the motor is totally enclosed and provided with forced ventilation through the air duct entering on the under side of the end bracket. The enclosure protects the motor from all foreign material which might otherwise settle on the winding, the collector rings and brush rigging. Besides this the constant air supply keeps the motor cool permitting it to deliver constant torque over a wide speed range.

✦ ✦ ✦

Motor Control

THE control of the d-c motor and the "synchro-tie' 'is interlocked to provide various features which insure safe operating conditions with a minimum of personal hazard and maintenance. The starting of the direct current motor is pushbutton controlled, and the field rheostat must be in the full field position providing maximum torque when starting or jogging the motor. Also, preset running speed is provided so that if for any reason it may be necessary to shut down during a run the unit can be readily brought back to the speed at which it was operating before shutdown. The direct current motor may be operated independently without the "synchro-tie" as might be desired when starting up a new run using different grade insulating rubber.

✦ ✦ ✦

PROVISION is also made that the d-c control must be in the deenergized position, and the d-c motor at approximately zero speed, before the "synchro-tie" connections can be made or broken. The receiver unit of the "synchro-tie" may be operated individually for inching or jogging service as may be required when threading wire through the unit.

✦ ✦ ✦

THE a-c and d-c control circuits are so interlocked that the main drive is inoperative if a-c power is not available. Thus, in the event of an a-c power outage which might be unnoticed by the machine operator, he would be unable to start the drive, or if the outage occurred while running the whole machine would be shut down, preventing the extrusion of excess rubber which might jam up in the vulcanizing chamber. Overload protection is provided by means of overload relays for both the d-c and the a-c units.

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Space Economy

ALTHOUGH the entire installation of the three individual

(*Please turn to Page 61*)

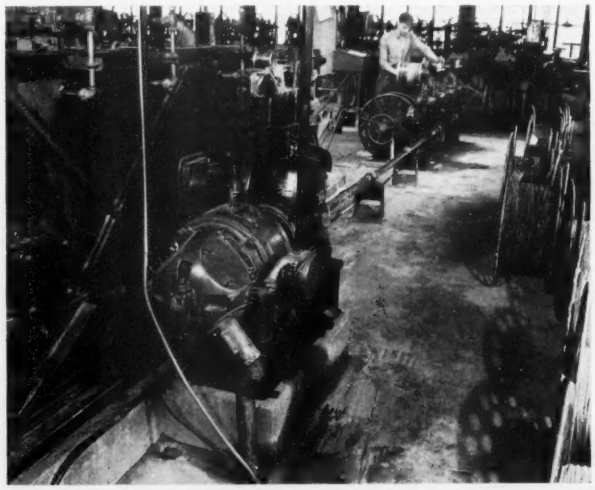

Figure 5. Totally-enclosed Forced-ventilated "Synchro-tie" receiver motor driving the take-up mechanism. ✦ ✦ ✦ ✦

Figure 6. The three Vulcanizing Chambers leave the tuber room and extend along the roof to the room housing the take-up mechanism. ✦

WIRE ASSOCIATION PROCEEDINGS

Meeting, Monday, October 20, 1941 - 2:30 P. M.

Chairman of Meeting

Sidney Rolle, Assistant Manager,
Scomet Engineering Co., New York, N. Y.

OPENING ADDRESS	**F. A. Westphal, Superintendent, Wire Mills, Past President, The Wire Association**	**Sheffield Steel Corp., Kansas City, Mo.**
PAPER: "The Cable Industry in National Defense"	**By Kenneth S. Wyatt, Cable Engineer**	**Phelps Dodge Copper Products Corp., New York, N. Y.**

Chairman Rolle: Needless to say it gives me great pleasure to have the opportunity of presiding at the first session of the Wire Association, but before we proceed with the interesting part of the meeting, I should like to make a few announcements.

(Announcements)

Chairman Rolle: This year the Chairman is going to have a very easy task because the Program Committee didn't think the Chairman could make an opening address. That is quite true, so this year we are particularly honored in having one of our good old stand-bys, Mr. F. A. Westphal to make the opening address. However I don't think anybody likes to call him that, so we are just going to call him "Dutch"; but before I present him, I should like to tell you a little about him. I know that many of you are well acquainted with him and know his history, but perhaps there are some newcomers here today so I will give you the highlights of his career. "Dutch" went to Annapolis and after he got through there, he decided the Navy was not fighting enough to suit his taste so he joined the Field Artillery. He went over-seas and saw plenty of action. He distinguished himself and I am very happy to say that he came back with quite a number of decorations, one of them for conspicuous bravery in action. I think that is something to be very proud of. After demobilization, he joined the American Steel and Wire Company, and following that he hooked up with the Sheffield Steel Co., with which company he is connected today; so with that little introduction it gives me very great pleasure to present—I won't say introduce—our good old friend "Dutch" Westphal. (Applause)

(Mr. Westphal here presented his address.)

Chairman Rolle: I am sure you agree with me that that was a truly inspiring speech. I hardly know what to say. "Dutch" even surprised me, and it takes an awful lot to surprise me these days. It was a splendid job. Coming now to the technical part of our meeting, we have a paper by Mr. Kenneth S. Wyatt, of the Phelps Dodge Copper Products Corp., of New York City. Mr. Wyatt only recently returned from England and perhaps many of you have not had the pleasure of meeting him, so I will just briefly outline his career. He was educated at Mt. Allison University in New Brunswick and later at Harvard. Then he joined the Detroit-Edison Company, and as I understand it from many of my friends from that city, he did a very splendid job there on cable research, particularly on high voltage cables; perhaps he will tell you a little more about that himself. Very early in his studies he became interested in plastics, and as I understand, is a real pioneer in this field. Mr. Wyatt was asked to deliver a lecture at the International Electric Congress in Paris in 1939, and about that same time I think he also did some lecturing in England. Following that he became associated with the Enfield Cable Works, outside of London, as Technical Director, where he remained until shortly before the outbreak of the war. Since his return he has been with the Phelps Dodge Copper Products Corp. It gives me great pleasure to introduce to you Mr. Kenneth S. Wyatt. (Applause)

(Mr. Wyatt then presented his paper.)

Chairman Rolle: I am sure you will all agree with me that Mr. Wyatt has just given us a very interesting talk. I happen to know some of the difficulties he labored under when he prepared this paper, and I am sure that had he been given carte blanche, he would have told us a great deal more, but I think he did a very fine job.

As the hour is getting a little late, I suggest we proceed at once with the discussion of Mr. Wyatt's paper. I take it that we are all in agreement with what "Dutch" Westphal had to say to us in his opening address and no discussion is needed. Please bear in mind when discussing Mr. Wyatt's paper that he is of necessity restricted in what he may say in reply to any questions put to him; but I am sure he will do the best he can in answering your questions. Does anybody want to ask Mr. Wyatt any technical questions? I see some of his competitors sitting around but they seem to be very quiet; I hope they are not squelched. I often wonder what a Chairman is supposed to do when confronted with big chunks of silence. Shoot somebody to bring out discussion or what? Well, if there is to be no discussion we shall proceed to the next item of the program—a sound moving picture, prepared by the Air Corps, entitled "History and Activities of the U. S. Army Air Corps." I haven't seen the picture myself but I understand it is extremely interesting and so I urge you all to stay and see what our Army Air Corps has to show us.

Chairman Rolle: Gentlemen, before we go, I want to express again our very great thanks to Mr. Westphal and Mr. Wyatt for their splendid papers, also to the Army Air Corps for the beautiful picture we have just seen. The meeting is adjourned.

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RICHARD E. BROWN, Secretary

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WIRE ASSOCIATION PROCEEDINGS

Meeting, Wednesday, October 22, 1941 - 10:00 A. M.

Chairman of Meeting

A. M. Reeder, Metallurgical Engineer,
Jones & Laughlin Steel Corp.,
Pittsburgh, Pa.

PAPER: "The Effects of Microstructure on the Galvanizing Characteristics of Steel"	By Robert W. Sandelin, Metallurgist	Atlantic Steel Company, Atlanta, Georgia
PAPER: "High Speed Rotary Knitting Machine for Covering Electrical Conductors"	By S. E. Brillhart, Technical Staff	Point Breeze Works, Western Electric Co., Baltimore, Md.
PAPER: "A Brief Discussion on the Manufacture of Steel for Arc Welding Electrodes"	By C. W. Garrett, Wire Mill Metallurgist	Aliquippa Works, Jones & Laughlin Steel Corp., Aliquippa, Pa.

PAPER: "THE EFFECTS OF MICROSTRUCTURE ON THE GALVANIZING CHARACTERISTICS OF STEEL"

Chairman Reeder: We have three very good papers on the program. The first paper to be presented this morning is entitled "The Effects of Microstructure on the Galvanizing Characteristics of Steel," by Robert W. Sandelin, Metallurgist of the Atlantic Steel Co. of Atlanta, Ga. This is the third paper on galvanizing which Mr. Sandelin will have presented before the Wire Association. His paper entitled "Galvanizing Characteristics of Different Types of Steel," was chosen as the Medal Award paper of the Wire Association for 1940. We are very happy to present Mr. Sandelin. (Applause).

(The paper presented by Mr. Sandelin was published in the October, 1941 issue of Wire and Wire Products).

Chairman Reeder: Mr. Sandelin is to be congratulated on his additional work on galvanizing and I know there are quite a number of practical galvanizers in the audience. There are two more papers to be presented this morning but I would like to hear a few comments on this paper by some of you gentlemen.

Mr. Gardner: I would like to ask Mr. Sandelin if the cold worked samples actually had the surface removed?

Mr. Sandelin: That is correct on the cold worked samples. For example, we worked them down from an inch and a half billet to about one-sixteenth oversize, so we had enough to grind off to get a smooth surface.

Mr. Gardner: In that case I was wondering if that does not account for some of the loss of effect of cold working in the finished galvanized coating?

Mr. Sandelin: Well, of course it is possible to have perhaps a very slight amount of increased cold work on the skin than further down. I think we will all agree on that, but that effect is too slight to be important. What you saw illustrated was actually what we had; in other words, those grains were distorted just the way you saw; that was the permanent condition of the pieces we galvanized, they were extremely hard and I would say that when you work a piece of steel from an inch and a half down to half an inch, there isn't going to be a great deal of difference in cold work as far as exact surface and one-sixteenth of an inch below is concerned. There has been so great a reduction in area that I know positively that the cold working has penetrated into the very inner portion of that steel; I am quite sure of that because I checked it metallographically.

Mr. Gardner: I was questioning this because it does seem to me a little contrary to the findings of actual galvanizing on the parts that we make.

Mr. Sandelin: I am glad you mentioned that, because that is exactly the thing we are trying to check up on. I am quite sure, though, that the skin effect there is not much difference than the surface of the reaction from galvanizing. I realize that in a case like this, we have ideal conditions. In practice we never galvanize anything with a nice ground surface, we have to pickle them and further I know that cold worked steels have a very much higher pickling rate; in other words, the pickling solution goes to work on them and you get absorbed hydrogen, which we know will tend to produce a gray surface, and under those practical galvanizing conditions, they would be somewhat different from what we have here. I grant that. We do a lot of galvanizing ourselves and sometimes these tests do not always correlate too well with practice, but we have to grind the surface to get comparable results, and when I give you this data, I say take it with a grain of salt because you have to take into account other practical galvanizing conditions that you cannot always avoid.

At this point a prepared discussion was presented by F. M. Morral, Asst. Professor of Metallurgy, Pennsylvania State College.

Discussion by F. M. Morral, Assistant Professor of Metallurgy, Pennsylvania State College on Paper Presented by R. W. Sandelin Entitled "The Effects of Microstructure on the Galvanizing Characteristics of Steel"

I am sure all galvanizers will appreciate Mr. Sandelin's work to determine the factors which influence the galvanizing of steel. The producer of hot galvanized articles is interested in giving the consumer what he wants: quality. This term includes such things as: uniformity of coating, proper appearance and weight of coating according to specifications.

The time honored study by the trial and error method is out because it is wasteful. In the future the hot dip galvanizer will have to meet stiff competition and he will need make use of all the science available. Mr. Sandelin has been going about in a methodic fashion to determine the factors which may affect quality.

We may not agree with some of the methods he has employed and conclusions he has drawn, but he certainly deserved the Medal Award he got last year from this Association for taking "the bull by the horns," since that is what the problem in galvanizing, and many others, needs.

Most of the literature on investigations on hot galvanizing have been published in foreign languages, so it is not surprising that Mr. Sandelin has overlooked some recent and interesting references. Radeker & Haarmann[1] have determined that steel is attacked by zinc in these three ways:

A) even surface attack which is predominant

B) localized hole attack

C) attack at grain boundaries.

The factors which affect the type of attack, which is mainly of the first type, may be summarized as follows:

1. evenly heated steel
2. chemical composition of steel
3. non-metallic inclusions
4. time and temperature
5. cold deformation on steel
6. chemical composition of zinc bath
7. stresses in the steel—this last one being particularly effective for attack at the grain boundaries.

The above factors may give you an idea of how complicated the study of the reaction steel and molten zinc is.

The work of Schwartz and Fromm(2) referred to by the author is in contradiction with later published data(3). It has been found that the formation of rough ridged surfaces is due to the presence of large cementite crystals. These appear to form a difficultly fusible alloy with zinc. On low carbon sheets I have observed unevenness in the alloy layer when cementite was present near the surface of the steel.

In a former discussion I have pointed out (4) that the type of sample used for this work would not give results which may be usable in commercial wire and sheet galvanizing because

a) of the shape of the specimens used

b) type of preliminary treatment

c) method of cooling — which was slow, particularly at the lower end of the sample.

The author's partially bright samples confirm this by being bright only on the lower part. This may be due either to the slow cooling, and possibly was due to the flowing of the zinc from the higher parts of the sample.

The selection of a square sample is somewhat unfortunate, since a round sample would have been so much simpler to machine, and would not have had such a pronounced effect on the growth of alloy layers(5). The surface appearance of the coating depends on the appearance of the alloy layers present.

The results obtained by Mr. Sandelin are of much interest and some of them may be explained on the basis of work already done,(1).

The effect of the variables studied by Mr. Sandelin on the appearance of the galvanized samples is due to chemical composition as was shown by him last year(6). If Aluminum were present in the bath(4) we might expect a decided brightening of the surface appearance of the coating because of the change effected on the surface tension of the zinc towards the steel, and of the chemical effect of the molten zinc on the steel.

The result of the following variables on the weight of coating are of academic interest, I believe.

a) Cold deformation increased coating weight slightly because of its tendency to grain boundary attack. By cold deformation energy is stored in the metal(7). This energy although small may favor slightly greater solution of the iron and zinc. It is also stated that cold deformation tends to increase the rate of diffusion. The data on appearance points to the formation of alloy layers; the author stated that a gray coating is indicative of a series of alloy layers. These same points apply to the difference in results found between coarse and fine grained steels.

b) I am particularly interested in the results obtained on carburized and carburized and hardened samples.

1. On carburizing the carbon is present as the intermetallic compound, cementite. On coating, this has a tendency to form rough coatings as was indicated at the beginning of this discussion. Further, the cementite favors the solution of iron to make alloy layers(8).

2. To harden the carburized sample, Mr. Sandelin had to heat the sample to the austenitic range. Did you analyze for carbon on the outside layers of the carburized samples, Mr. Sandelin? In this range all the carbon—or carbide—this subject is still cause for much debate by the metallurgists, is dissolved in the iron. On quenching rapidly this carbon, or cementite, is not thrown out of solution. The phase obtained, ma t cusite, has two characteristics:

1. It is a solid solution of iron.
2. It is highly strained.

The results shown indicate that very little alloy layer is formed—the appearance is bright—and the actual weight of coating is less (35%) for the 30 second immersion, than for the previously mentioned carburized condition. This gives a neat proof of the activating effect of cementite on the corrosion of steel by molten zinc. This is particularly true on comparing with the result presented in this paper that straines in the steel have only a small effect on the weight of coating.

Water quenching of the billet had also an effect of lowering the weight of coating on the A Steel, a high silicon steel, although the effect was only 11%.

The weight of coating of fine grained steels appears to be from 78 to 100 per cent that of the coarse grained steel depending on chemical composition, of the steel. This again points to the importance of composition of steel.

From the two papers presented by Mr. Sandelin I think it is safe to make the following conclusions; on factors affecting hot dip galvanizing quality:

a) the effect of chemical composition of the steel is critical. The presence of carbon and its form has a definite influence.

b) grain size may have a slight effect although it is subordinated to (a) above.

c) deformation has only a slight — practically negligible — effect. From other data the following should be added:

d) the time of galvanizing and the temperature of the spelter(9).

e) the galvanizing bath composition has a definite effect(10).

References

(1) Radeker and Haarmann, Stahl und Eisen, vol. 59, 1940, p. 1217.

(2) M. von Schwartz and H. Froom reference 2 in paper, 1935.

(3) H. Bablik, F. Goetzl, and R. Kukaczka, Zt. f. Metallkunde, 31, 1939, p. 287.

(4) F. R. Morral, discussion Wire and Wire Products, vol. 16, 1941, p. 58.

(5) H. Bablik, The reaction of Zinc and Iron in Hot dip galvanizing, Metal Finishing, vol. 38, 1940, p. 531.

(6) R. W. Sandelin, Wire and Wire Products, vol. 15, pp. 655, 721, vol. 16, 1941, p. 28.

(7) C. H. Desch, Metallography, 1937, p. 274.

(8) Reference 5 above, p. 586.

(9) H. Grubitsch and F. Bruckner, Thickness of layer, bendability, and spangle formation of hot galvanized sheets. Korrosion and Metallschutz, vol. 13, 1937, p. 254.

(10) Scheil and Wurst, Zt. F. Metallkunde, vol. 29, 1937, p. 228.

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(Answer to Professor Morral's Discussion)

I very greatly appreciate Professor Morral's careful study of my paper and his comments. In regard to the appearance of ridges on coatings, particularly for long immersion times, it has been observed that quite frequently on high phosphorus steels, unevenness is evident in the form of depressions of narrow width in the direction of rolling. These depressions are just the reverse from ridges. The reason for their formation has not been determined. Ridges and depressions are evident only for the long immersion times. Rimmed Steels low in silicon and phosphorus have generally smooth coatings.

The presence of aluminum in the bath has a brightening effect on a coating but its presence will not change a coating from the gray, iron-zinc alloy type to a spangled type because the latter results from the presence of a pure zinc layer over the iron-zinc alloy layer.

The carbon content of the case on the carburized samples was not determined chemically, however, it was checked by metallographic means and found to be of approximately eutectoid composition.

Chairman Reeder: We have time for one more question or comment. Does anybody have anything to add to the paper or any questions you would like to ask Mr. Sandelin? If not, we will go on with the next paper. The next paper to be presented should be of special interest to all people associated with the manufacture of wire. I am pleased to present at this time Mr. S. E. Brillhart, a member of the technical staff of the Western Electric Co., Point Breeze Works, who will speak on "High Speed Rotary Knitting Machine for Covering Electrical Conductors." Mr. Brillhart.

(The paper presented by Mr. Brillhart was published in the October, 1941 issue of Wire and Wire Products).

Chairman Reeder: I want to thank Mr. Brillhart for his very fine paper, and after the meeting is over, those interested in seeing the samples can come up and look at them. We will have to go right on to the next paper now because the time is getting pretty much limited. Our next speaker is Mr. C. W. Garrett, Wire Mill Metallurgist of the Jones & Laughlin Steel Corp., Aliquippa Works, Aliquippa, Pa., and the title of his paper is "A Brief Discussion on the Manufacture of Steel for Arc Welding Electrodes."

(The paper presented by Mr. Garrett was published in the October, 1941 issue of Wire and Wire Products.)

Chairman Reeder: I am sorry our time is pretty well up, but we have got another session this afternoon with three papers to be presented and I am afraid we are going to have a very limited amount of time for discussion. I notice some of our Pittsburgh Steel friends in the audience and I wondered if they might have any points to bring out regarding Mr. Garrett's paper? I expected there would be some differences of opinion.

Mr. S. A. Braley, of the Pittsburgh Steel Co., Pittsburgh, Pa.: In the first place, Mr. Garrett mentioned the possibility of the iron oxide from the lapping. I wonder if any determination has been made of the additional oxygen or oxide content of the metal as a whole, from any scale which may be occluded in the lap of that type, from a gas analysis determination?

Mr. Garrett: We started to make gas analysis for oxygen. I think we made seven or eight different sets but couldn't get any logical agreement.

Mr. Braley: The reason I asked that question is because the iron oxide of the steel is about 25%.

Mr. Garrett: Twenty to twenty-five.

Mr. Braley: That is the slag analysis.

Mr. Garrett: It is.

Mr. Braley: If that is the case, would you expect a higher oxide content in the metal at equilibrium in a heat than you would a lower oxide content?

Mr. Garrett: That depends on the heat conditions at the time of tapping. Is the oxide in the bath always in equilibrium with that of the slag at the time of tapping?

Mr. Braley: Not necessarily equilibrium, but it would approach it and you would expect a higher oxide content from a higher oxide slag than from a lower oxide slag.

Mr. Garrett: Under normal conditions that is true, but take a specific case, your heat is about finished and your melter finds out that his oxide content is too high, so he starts to bring it down. He goes to work and lowers it; but by the time he taps that heat, is the oxide in the slag and in the metal still at equilibrium?

Mr. Braley: I was just asking those questions because personally we have run a very large number of oxide determinations in weld metal and in filler metal as deposited and attempted to correlate that with the strength of the weld on various and sundry analyses of steels, and published a lot of that work in the American Welding Society which applies to that very point, now, because of that condition, and we know also that every manufacturer has his own private stock when it comes to fluxes. It is possible to take a very wide variation of wire, put them with two, three or half a dozen different fluxes and run up the welds and make determinations, and you will find that you have a reversal and some fluxes will work with some wires and other fluxes with other wires; in other words, you also have to reach an equilibrium when it comes to wire as between the manufacturer's flux and the metal. In the manufacture of steel you have an approximate equilibrium between metal and slag; the composition of the slag is dependent on the way in which the heat is worked and the amount of lime, etc., added, but is not flexible. When you have an arc weld, you have in substance a miniature electric furnace in which you again will have approximate equilibrium between your metal and the slag. This time however instead of being dependent upon the work of the melter in order to get the metal you desire with the slag that you have available, you have now a pre-determined metal and slag, and if the slag is not sufficient for a proper composition to react to give a solid weld, you will not get a good weld. Now that is the theory upon which we have worked, and I simply call attention to these as we go along because of the work that we have tried to accomplish on it from the standpoint of oxide content that you have mentioned.

Mr. Garrett: How far are you going to carry that comparison between the conditions under the electric arc and the open hearth furnace? We have given it attention along the line you mention.

Mr. Braley: You do not have the same type or point of equilibrium but you will have approximate equilibrium which will be standard under that particular condition and with any welding electrode; if it is the same base metal, the temperature of the melting will be approximately the same but the equilibrium will not be the same, dependent on the composition of the flux. On that we have not only determined the oxide in the metal but also complete slag analysis from each composition, which also correlates back to this equilibrium condition. That is the point I make in discussing this problem for what it is worth.

Chairman Reeder: We have time for about one more question or comment if anybody would like to make it. If not, I want to take this occasion to thank the speakers of this session and the meeting stands adjourned.

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WIRE ASSOCIATION PROCEEDINGS

Meeting, Wednesday, October 22, 1941 - 2:00 P. M.

Chairman of Meeting

Dr. S. A. Braley, Chief Metallurgical Field Engr.,
Pittsburgh Steel Co., Pittsburgh, Pa.

PAPER: "Stainless Steel Wire for the Aircraft Industry"	By J. K. Findley, Metallurgist	Allegheny-Ludlum Steel Corp., Dunkirk, N. Y.
PAPER: "Diamond Dies for the High Speed Drawing of Copper Wire"	By H. N. Padowicz, Engineer	Western Electric Co., Kearny, N. J.
PAPER: "Electrolytic Zinc Coated Wire"	By L. H. Winkler, Metallurgical Engineer	Bethlehem Steel Co., Bethlehem, Pa.

PAPER: "STAINLESS STEEL WIRE FOR THE AIRCRAFT INDUSTRY"

Chairman Braley: The meeting will please come to order. Even a year or two ago any one speaking to us on stainless steel was very interesting. We all learned yesterday from the very fine talks we had at the luncheon, that a good deal has happened and there is a great deal of stainless wire being used in various and sundry places, especially in tanks and the aircraft industry today. I am sure we are going to be very much pleased to hear what Mr. J. K. Findley has to say about "Stainless Wire for the Aircraft Industry."

(The paper presented by Mr. Findley was published in the October, 1941 issue of Wire and Wire Products.)

Chairman Braley: I am sure that because of the importance of this subject there will be a number of questions you will wish to ask. In the first place, if we consider the statement Dr. Findley made a few years ago when he presented a paper on this subject, we have gone a long way and I think his predictions of a long way to go are very good. Are there any questions that any one would like to ask Mr. Findley? Don't hesitate to ask him, although there are some questions he may not want to answer or may not choose to answer, whichever way you wish to put it. There is no harm in asking any questions you have on your mind. There is one question I might bring up that may be on the minds of some, and that is relating to inspections by government inspectors, whether or not you have difficulty with them, etc.

Mr. Findley: I would say no, but there was difficulty at first. It was all due to a lack of understanding. Maybe they did not understand what they wanted and we did not understand what they wanted, what could be made, but that is all over.

Chairman Braley: Are there any other questions? If not, we thank you very much, Mr. Findley for this very interesting and valuable paper. (Applause).

PAPER: "DIAMOND DIES FOR THE HIGH SPEED DRAWING OF COPPER WIRE"

The next paper on the program this afternoon is on the subject of Diamond Dies for the High Speed Drawing of Copper Wire. In these days there are a good many problems of "ersatz" materials. I don't know that we could call diamonds "ersatz," although I have known of suggestions to use gold for trimming automobiles, etc., so maybe the substitution of diamonds for money would be on the same line. I am sure that is not what the next speaker has in mind, however. Mr. H. N. Padowicz will now present his paper entitled "Diamond Dies for the High Speed Drawing of Copper Wire."

(The paper presented by Mr. Padowicz was published in the October, 1941 issue of Wire and Wire Products.)

Chairman Braley: I am sure that this is a very enlightening paper on diamond dies, but haven't we many people here who are interested in other wire than copper. Are there any questions?

Mr. Cohn of the firm of Sigmund Cohn: There are two questions I would like to ask. Could you tell us in a little more detail just how the angle of the entrance and exit of the die is measured? And, second, have you any information as to whether the length of the bearing of the die or the angles of the exit and entrance should be different for the different types of metals?

Mr. Padowicz: With regard to the measuring of the die angles, that is simply done by pressing a small lead slug into the die hole until it is flat with the upper face of the die mounting. The size of the slug should be such as to have a part of it extrude out through the die exit side. This plug is then withdrawn. It retains the impression of the die contour. For the exit angle, the relief angle, the die position is reversed and the same procedure is followed. The flat base of the plug is then mounted on a contour projector, an instrument which is much used in the tool industry for checking gear teeth and tool shapes. A shadowgraph of the die impression, projected at a magnification of a hundred times is traced on a cardboard sheet. The angles and die contour are then scaled. Usually a line is drawn at the level of the mounting face and from that we make all our measurements. Knowing the thickness of the die mounting and the magnification, the shadowgraphs of the die impressions can be matched to give the full die contour.

In answer to the second question, the copper wire industry has found a reduction angle of sixteen degrees or as more commonly noted, a half angle of eight degrees, to be best for the drawing of copper wire. This was determined by practical experience over a long number of years. I believe that with the harder metals, such as the ferrous metals, the dies "pull out" or wear oversize more frequently, and in order to get economical die wear it is necessary to have tighter reduction angles and longer bearings.

Mr. Cohn: Thank you very much.

Mr. Reeder: What final wire sizes are being referred to?

Mr. Padowicz: We are actually drawing at the speeds noted, nineteen to twenty-six A.W.G. sizes. This is roughly thirty-six thousandths of an inch down to sixteen thousandths.

Mr. Reeder: The drawing speed of five thousand feet which is mentioned; what does that refer to?

Mr. Padowicz: It is about the average maximum drawing speed for the same range of the noted wire sizes, that is now being used in this industry.

Mr. Sidney Rolle: I should like to ask the speaker, have you had any experience with ersatz materials which could be used in place of the diamond dies?

Mr. Padowicz: No, we have not. The nearest possible substitute I know of, is the cemented carbide die. In our experience we have found them unsuitable for economical copper wire drawing operations at the sizes noted. They have not as yet proved feasible for drawing at these wire sizes.

Mr. Cohn: I understood you to say that the sizes you draw are from .036" to .016". Our problems are around one to two thousandths of an inch. Do the same problems apply to diamond dies of these sizes?

Mr. Padowicz: I would say so. However, the die pressures are so much lower, I do not believe that the breakage would be as an important factor here as the actual wear to oversize. The stresses in the die depend on the gauge size, the drafting procedure and the material being drawn. Of course, the heat generated in the die is directly proportional to the work done in that die. This is again proportional to the deformation taking place there. At the very small sizes the amount of heat and the magnitude of the stresses involved are so much smaller, that some of the problems which we have, do not exist.

Chairman Braley: Are there any further questions? Mr. Padowicz, we thank you.

PAPER: "ELECTROLYTIC ZINC COATED WIRE"

Dr. Braley: The next speaker has a subject of interest to all of us, especially since the zinc situation is such as it is in the country. I hope he will tell us how we can get zinc to compete with this or that product. I am sure that whatever method or suggestions Mr. Winkler may have for us on this subject will be appreciated. The next speaker will be Mr. L. H. Winkler and the subject of his paper is "Electrolytic Zinc Coated Wire."

Mr. L. H. Winkler: I don't know where we can get zinc today; it is almost as bad as getting steel.

(The paper presented by Mr. Winkler was published in the November, 1941 issue of Wire and Wire Products.)

Chairman Braley: I am sure that this paper has been appreciated very much, and as far as I am concerned, has been the most complete description of the process in which we have all been very much interested that I have ever heard. I suppose there will probably be some questions on this. I suppose Carl Johnson is going to answer the questions.

Mr. Winkler: He will have to.

Chairman Braley: Are there any questions?

Mr. B. L. McCarthy: I would like to compliment Mr. Winkler for this very wonderful paper, also the able manner in which he handled the most difficult discussion of the Preece Test as compared with the ounces of zinc per square foot of surface for corrosion resisting properties; also for the reference to contamination and the importance of contamination in connection with these tests.

Mr. Winkler: Thank you, Mac.

Chairman Braley: I think that is very well put. I second that motion.

Mr. F. A. Westphal: I would like to ask a question, but I think it might be unfair. If it is, say so. Is it fair to ask for the comparison in relative percentage costs with bethanizing and with hot galvanizing? We will start say at Type I on the hot galvanized, then type 2 on the hot galvanized and type 3 on the hot Bethanized. I am not asking for actual money but just the increased percentages, ten percent or thirty percent or what? In giving that cost, I would like you to bear in mind the capital expenditure if that is available. If it is not, just say you don't know or it is unfair.

Chairman Braley: I have been under the impression that for very light coatings, No. 1 electrolytic is possibly as cheap or cheaper. The half ounce, it is about a toss-up; in coatings around nine-tenths of an ounce, the hot dip is ahead, and above that, hot dip is out.

Mr. Winkler: With cheap zinc perhaps you are right also, I haven't made any cost analysis, but my general impression pretty near parallels yours. Of course another thing you must bear in mind, these units of ours were built or grew more or less like Topsy and we have had demands on us for quoting weight ranges that nobody ever thought of. I don't know any galvanizing unit on which you can go from perhaps four-tenths of an ounce up to five ounces in the same unit and obviously if you had a definite standard product that you could design your unit for, if you only had a finish mill, you might roll four inch bars.

Mr. Westphal: Are those cathodes made of silver?

Mr. Winkler: The anodes are made of lead silver alloy which happens to be stable in this acid solution of sulphate and is not attacked.

Mr. Westphal: The cathode or the anode?

Mr. Winkler: The anode. These are the anodes from which the current flows through the electrolyte to the wire and out through those cathodes. Of course you do not see the anodes because they are underneath the surface of the electrolyte. They are lead-silver. It happens that that alloy of lead silver—I think it is around two percent silver. It is insoluble or practically insoluble in this acid sulphate solution.

Mr. Westphal: Then their life is indefinite?

Mr. Winkler: Yes; of course after a while, like everything else, you replace them from time to time; I don't know how frequently they are replaced. Certain bucklings and warpages take place that we have been correcting by changes in mechanical design in our anodes, and they last much longer than when we first started.

Mr. McCarthy: I would like to refer to Mr. Braley's question on the relation of cost, to the amount of the coating. As I understand it you said it figures up to around .5; the electrolytic coating is lower; isn't that right?

Mr. Winkler: That is quite right

Mr. McCarthy: Your fuel balance sheet against your electric power, is it appreciable because there is a small amount of power; then, around .5 it starts to increase, and then the electric power cost goes over the fuel costs and you go on up to the point of higher coatings. The question I wanted to ask is this: Would the expense of that background of equipment required to prepare the electrolyte be such as to upset that balance that Mr. Braley pointed out in the lower coating ranges? Does that still persist in connection with the Bethanized process?

Mr. Winkler: He was referring to the whole thing.

Mr. McCarthy: What I mean is, the figures I have on the lower cost in values under .5, did not pertain to the Bethanized process; is that true of the Bethanized process also on the lower weight coatings?

Mr. Winkler: I would think so.

Mr. McCarthy: I was wondering if the background of cost in connection with the preparation of the electrolyte might upset that?

Mr. Winkler: No, I don't think it would; that would be my guess at it. Of course, fortunately or unfortunately, I do not know very much about the cost, the selling prices or anything else in that line.

Mr. McCarthy: While I appreciate the fact that you have created a new market because of your extremely heavy coating, I still think there is quite a field for extremely low coatings, such as coat hangers and a million applications where you can really put on electrolytic coating cheaper than the hot dip.

Mr. Winkler: I don't know. I believe still that the hot galvanizing process is pretty good.

Mr. McCarthy: The figures that I have seen check pretty well. There is some compromise to be expected, especially on the four one-minute coatings when you get down to values as low as .1 and for a lot of inside applications that is plenty, the relative cost is much less.

Mr. Winkler: That is possibly one of the reasons that the strips used for BX gauge labels were electro-galvanized, in order to give an idea of the comparative cost. When you are covering such a large range, I rather believe that something like BX steel, the best coat, is the electro-plated system; it is reasonably low cost and a nice product.

Mr. Westphal: I would like to ask a question about the steel; I would like to have your opinion on the ratio of life on steel that has no copper, that is just residual copper, and steel that has about .20 to .30 copper; what is the proper solution that increased the life, due to putting the copper into the steel?

Mr. Winkler: That will vary considerably with the location.

Mr. Westphal: Assume you get the same location for comparative tests.

Mr. Winkler: You take a place like Pittsburgh, it would be one ratio; State College, Pa., would be another. The A. S. T. M. Committee A-5 has practically completed all of their exposure tests of the uncoated sheets exposed at a great number of locations throughout the United States, and in the recent report of a few years ago by Committee A-5 to the A. S. T. M., you will find quite an analysis that is very interesting and will show you the relationship not only on your copper bearing problem but on the comparison of open hearth with bessemer steel sheets, and copper bearing with non-copper bearing sheets, and I do not believe it would be fair to even hazard an estimate as to what the improvement is. We have found out this from those exposure tests, that copper in steel does inhibit rust, it delays rusting, and probably the reason for it is because, as a result of this copper alloyed with steel, the oxidization product, (the rust film) is of slightly different character than on non-copper bearing steel, a little more tightly adhering, not quite so soft and a little more impervious. You have seen wire with copper in it which, when it is rusted, appears to have been lacquered. Such a rust film acts as a protection to the steel. The copper in the steel will not keep that steel from rusting, it will rust, but not as fast after the first stage of rusting. This appears to be due to the character of the outside rust film. Stainless steel owes its property of stainlessness not to the steel itself but to the fact that the oxide film formed on the stainless steel though transparent, is continuous, impervious and protective to the stainless steel underneath that film of oxide.

Mr. Westphal: There is no question but what copper bearing increases the life of the wire.

Mr. Winkler: In atmospheric exposure; the work of A. S. T. M. Committee A-5 definitely pointed to that fact.

Mr. McCarthy: I think that the value of copper, especially from a sales standpoint, has been grossly exaggerated.

Mr. Winkler: That often occurs. A short time ago the grain size control got so bad I was worried about controlling the grain size controller.

Mr. Ray Simmons: I think it would be interesting if Louis gave us some indication of the change of physical properties that takes place when high carbon wire is subjected to the Bethanizing process. For instance, if .091" Improved Plow wire with a tensile strength of 275,000 pounds per square inch, elongation of 1½%, 40 torsions, what would be the physical properties of that wire after subjection to the Bethanizing process?

Mr. Winkler: If you are asking about our Bethanized rope wire, I would say the specifications for our Bethanized rope wire are the same as we use for our bright ungalvanized rope wire.

Mr. Simmons: Would the elongation change?

Mr. Winkler: We don't make elongation tests as a routine procedure. I know some like elongation tests; I don't like them; I don't think they are of much use and it is too much trouble to make them. We prefer torsion tests as a measure for ductility. Practically all of our Bethanized wire is coated at the patenting point and drawn to the same total reduction as employed in uncoated wire.

Mr. Simmons: You don't coat wire in the finished or desired size?

Mr. Winkler: All of our ropes where we want to get the equivalent results that we could expect from bright wire, are made from wire coated at the patenting point. Even in cases where it is desired to coat finished wire, the temperature range in cleaning with caustic is quite broad; one can clean and anneal at six hundred or seven hundred F., or at a given temperature up to thirteen hundred and fifty degrees F., depending on results desired.

Mr. McCarthy: Wouldn't it be safe to say that going through caustic without any prior treatment, would be the same as going through the hot zinc avoiding the lead, and should give you physical properties which should be about in line with the ordinary hot-dipped galvanizing operations?

Mr. Winkler: Yes, I think we might be able to get a little higher tensile.

Mr. McCarthy: But I would expect that the elongation in that case would go up to around 5%.

Mr. Winkler: If we carried out the operation simulating the same conditions we have in hot galvanizing, we would get the same physical properties as far as the elongation is concerned. As a matter of fact, in making strand wire to meet the elongation requirements, we employ the annealing effect prior to Bethanizing — that is, in meeting the A. S. T. M. standard requirements for strand wire, we follow similar means as in the hot galvanizing; we cannot get them any other way.

Mr. Simmons: The proportions would not be varied at all?

Mr. Winkler: I have not seen any difference in the physical characteristics of Bethanized wire as against charcoal wiped wire in making strand wire. We must remember, however, that when we go into the heavier coatings, one will have a smaller cross-section of steel which must be taken into account when preparing a given size of coated wire to meet a given specification.

Mr. McCarthy: In that connection there is one change in the physical properties on galvanizing that few of us encounter; you can raise the tensile strength of wire by hot dipped galvanizing.

Mr. Winkler: Yes.

Mr. McCarthy: If you get your exposure just right, you can raise it?

Mr. Winkler: Yes. Speaking of rope wire, by drawing wire coated at the patenting point, one can produce rope wire having a tensile of 350,000 pounds to the square inch drawn from Bethanized stock of 85 carbon steel. We made some wire for some small rope and got pretty close to 400,000.

Mr. Donachie: In the production of these different weight coatings is there a difference in the effect produced on the steel base itself by the cathodic action?

Mr. Winkler: We have not noticed any. Some people thought that perhaps we have, but if you have got hydrogen trouble because it is from the zinc bath, you don't need to worry about the hydrogen in your steel, about the regulation of the coating weight, that depends upon the time and the amperage.

Mr. Donachie: There is one more question I would like to ask. Independent of any standard weight specification that is commercially used, it would seem that, due to the type of coating, galvanizing and electroplating there would be a difference in corrosion values. What have you done in the laboratory to measure that?

Mr. Winkler: We have not done anything in the laboratory to measure it because I do not believe these accelerated tests are worth much, and we can get a better answer to that direct question after this series of tests that Committee A-5 is now running have progressed further. I don't know positively whether one type of zinc coating is going to be any better than another. But I do think the protection will at least be proportional to the weight of zinc as measured in ounces per square foot of wire surface. This is my own conservative feeling about the question.

Mr. Westphal: On your A. S. T. M. research of exposure tests on the analyses that are merely comparable, say in carbon and manganese, is basic open hearth showing a superiority against corrosion over Bessemer?

Mr. Winkler: No, I will say that the tests showed Bessemer was sometimes better than open hearth.

Mr. Westphal: That's better than twenty years ago, isn't it?

Mr. Winkler: Sure, that is why I warn you against accelerated tests. Twenty years ago accelerated tests were made, you can find in the literature a lot of data on the results of certain work done by those investigators. I know they were honest in their convictions and the conclusions they drew from those accelerated tests; that is why I say that frequently accelerated tests are not sustained under actual service conditions. Nobody would be happier that I would be or anybody else if we had a mind that was capable of inventing a laboratory test that would, in a short time, give more accurate insight into problems of corrosion than our accelerated tests at present do as to what we might expect in twenty years from now.

Mr. Westphal: You will agree with me that the tests of fifteen or twenty years ago showed basic open hearth superior to Bessemer?

Mr. Winkler: Those accelerated tests did, but at the same time many of us had seen out in the field, fences made of Bessemer steel many years before that stood the ravages of time very well.

Mr. Westphal: Bessemer or basic?

Mr. Winkler: Bessemer. Bessemer was made before basic. Thirty years ago there was more Bessemer steel made in this country than basic.

Mr. Westphal: Why? Because it was cheaper?

Mr. Winkler: No, I would not say so but rather because it was developed first. Bessemer preceded open hearth, and what I was going to say was that there was a lot of Bessemer steel made much longer than twenty-five years ago that had been exposed and some of us had watched it and knew that it was pretty

good. Many of the so-called "low alloy steels" for high strength and corrosion resistance have phosphorus as part of their composition for the purpose of inhibiting corrosion as well as strength and I believe that perhaps the idea may have at least in part resulted from this comparison of Bessemer and open hearth in these A. S. T. M. exposure tests.

Mr. Westphal: The chances are that the quality of Bessemer has been greatly improved in the last five years.

Mr. Winkler: So has open hearth.

Mr. Westphal: Yes, but I still do not agree with you that Bessemer is better than basic.

Mr. Winkler: You asked me what the A. S. T. M. tests showed, and I told you that they showed that the Bessemer was better than the basic. (Laughter) I am not going to give you any personal opinion.

Chairman Braley: Those tests are all published and I would suggest you study them over. Your probably can prove your point if you want to pick out isolated cases in those tests, but I agree with Lou that in general the thing he has stated is correct.

Mr. Westphal: How long have they been out?

Chairman Braley: The sheet tests have been out about twenty years; the wire tests, five and a half years.

Mr. Westphal: I thought they were incomplete.

Chairman Braley: The wire tests have been out five years.

Mr. Westphal: But they are not complete yet?

Chairman Braley: They are only indications, but the indications follow the same line.

Mr. Westphal: The final tests have not been reached on the A. S. T .M.?

Mr. Winkler: On wire they have not, but they have been on sheets. They are only five years old; they will probably run another fifteen years. (Laughter)

Mr. Westphal: Then we will have to wait fifteen or twenty years to answer the question.

Mr. Winkler: For the ordinary product; for our wire, fifty years. (Laughter)

Chairman Braley: It is getting late and I want to thank Lou for his wonderful paper that he has given us. There's one thing I would like to mention; this morning we got started awfully late in this meeting. Now the program for tomorrow morning is set for 9:45, but we are going to give you an extra fifteen minutes to sleep, but the meeting is going to start at 10 o'clock. Let's start on time. The session is adjourned.

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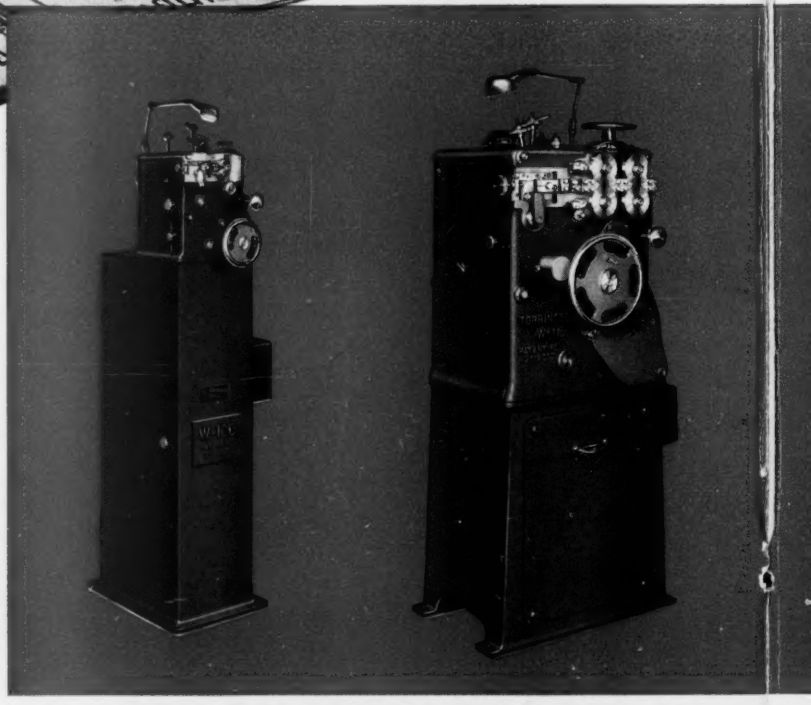

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MODEL W-11 Segment Type Spring Coiler. Wire diameter range: .015″ to .072″. Wire length per spring: 0″ to 42″. With extra gearing, small diameter wire .047″ may be coiled from 0″ to 83″. Coil range, outside diameter: 3/32″ to 1-9/16″. Springs per minute: 23 to 190. Space required: 28″ x 36″. Weight of machine: 950 lbs.

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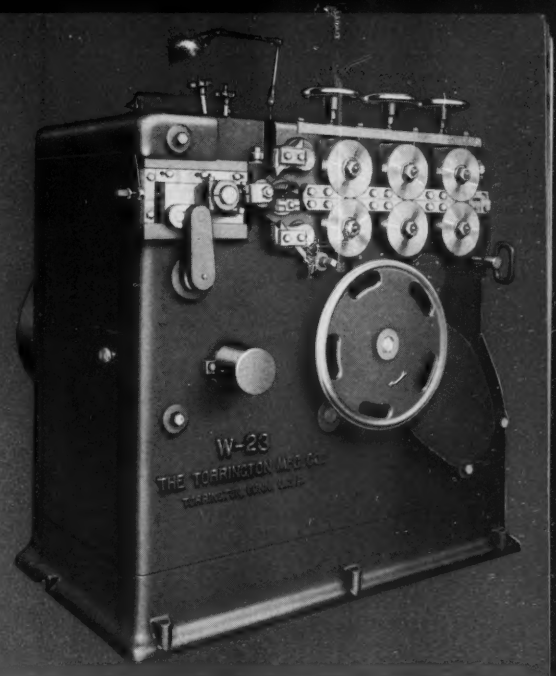
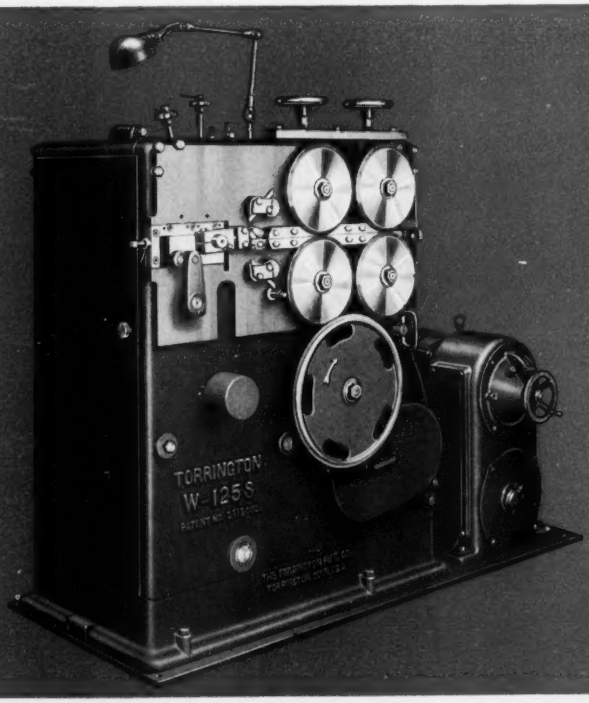
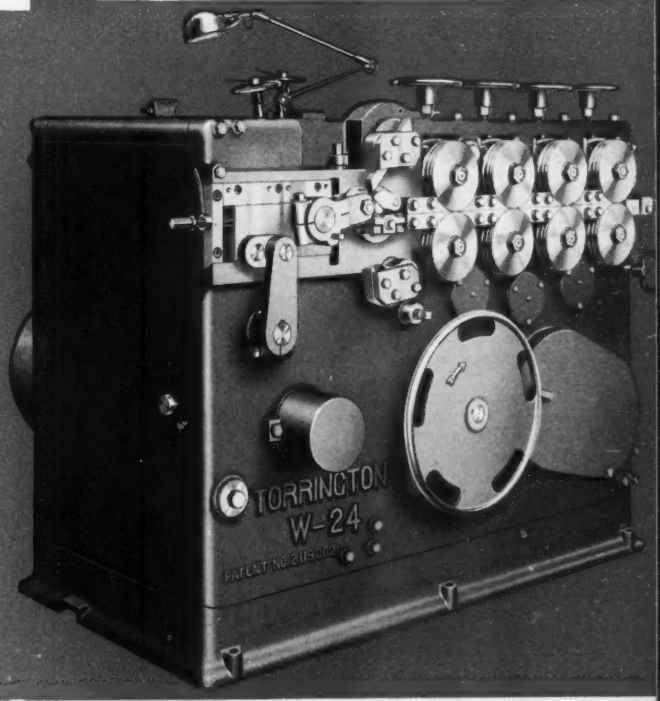


MODEL W-23 Clutch Type Spring Coiler. Wire diameter range: .092″ to .282″. Wire length per spring: 2″ to 648″. Coil range, outside diameter: 3/4″ to 4 1/4″. Springs per minute: 2 to 60. Space required: 64″ x 68″. Weight of machine: 8,100 lbs.



MODEL W-125S. Segment Type Spring Coiler. Wire diameter range: .105″ to .250″. Wire length per spring: 0″ to 75″. With extra gearing, small diameter wire may be coiled from 0″ to 145″. Coil range, outside diameter: 3/8″ to 4 1/4″. Springs per minute: 13 to 77. Space required: 86″ x 60″. Weight of machine: 8,300 lbs.



MODEL W-24 Clutch Type Spring Coiler. Wire diameter range: .187″ to .500″. Wire length per spring: 3.6″ to 815″. Coil range, outside diameter, 1″ to 6″. Springs per minute: 2 to 50. Space required: 74″ x 80″. Weight of machine: 14,800 lbs.

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WIRE ASSOCIATION PROCEEDINGS

Meeting, Thursday, October 23, 1941 - 9:45 A. M.

Chairman of Meeting
C. H. Hannon, Metallurgist
General Electric Company, Pittsfield, Mass.

PAPER: "Time, Temperature and Size in the Heating of Steel Wire"	By R. R. Tatnall, Metallurgist	Wickwire Spencer Steel Co., Worcester, Mass.
PAPER: "Production of Commercial Bronze Screen Cloth Wire"	By B. H. McGar, Assistant Director of Research	Chase Brass & Copper Co., Inc., Waterbury, Conn.

PAPER: "TIME, TEMPERATURE AND SIZE IN THE HEATING OF STEEL WIRE."

Chairman Hannon: There has been some criticism of the lack of promptness in starting the Wire Association meetings, and a consequential lack of coordination between the other societies and this one. Some of the boys that wished to attend meetings of the various societies, found it rather difficult to coordinate their attendance. After last night I suppose we ought to feel complimented and feel proud that we are able to be here this morning. While it is their loss, undoubtedly there will be a lot of other come-laters, but in the meantime we must proceed. Aside from complimenting those who are in attendance this morning, I feel that we should recognize at this time the effort that has been put forth by all who prepared papers for the Wire Association meetings. We all say we are busy. These gentlemen have given extra time, undoubtedly much of it their own. Personally I feel that the Association would do much better to show a little more consideration by better attendance. (Applause) We have two gentlemen speaking this morning. The first is Mr. Tatnall, who has received honorable mention this year. He has done a fine job. He is with the Wickwire Spencer Steel Co. and since 1930 has been in charge of experiment and research on springs and spring materials. His paper this morning is on the subject of "Time, Temperature and Size in the Heating of Steel Wire."

(The paper presented by Mr. Tatnall was published in the October, 1941 issue of Wire and Wire Products.)

Chairman Hannon: Some of us here probably are more interested in nonferrous than in ferrous metals. That happens to be my case. I don't know that I can presume to head any discussion here this morning, but the paper is now open for any discussion from the floor.

Mr. Braley: Mr. McCarthy has asked me to read these comments on this paper.

Written Comments by Mr. B. L. McCarthy

"I wish to compliment the author for the work done, and the effort put forth in the preparation of this paper.

I am inclined to question the results showing that in some cases the reduction in area has reached a constant value in a time of less than 135 seconds, as this is not in line with results obtained by the writer. When we consider that, all other factors being equal, the reduction in area values as determined on the air-cooled specimens have a direct relation to the austenitic grain size which existed in the sample prior to cooling, it follows that a constant reduction of area indicates grain size equilibrium. I question whether grain size equilibrium can be obtained in such a short period of time.

In my opinion, the Rockwell hardness test would have been more valuable on the as-quenched samples, for showing the results of oil-quenching. It did not seem that temperature and time for drawing after oil-quenching were clearly defined, and I feel that the method employed should be more fully described as the statement that they were drawn in lead at temperature which gave approximately normal physical properties, does not seem sufficient to bring out the true value of the results.

The curves shown for air-cooled muffle-heated specimens with some exceptions and variations follow curves obtained in Buffalo some years ago in developing a means of determining the tensile strength of air-patented rod or wire.

The heating methods cited are only radiation and conduction. The majority of air-patenting furnaces today are open fired and the importance of flame radiation, a factor not considered in this paper, as well as convection heating, which is always present in this type of furnace cannot be overlooked."

Mr. Braley: These comments are those written by Mr. McCarthy. I am simply reading them at his request.

Chairman Hannon: Do you wish to comment, Mr. Tatnall?

Mr. Tatnall: In view of the fact that Mr. McCarthy is not here, I reserve the right to reply to this discussion of his in writing.

The following is the reply to Mr. McCarthy by Mr. Tatnall.

"In reply to Mr. McCarthy's comments, the author first suggests a reference to either Figure 4b or Figure 8 of the paper. In either of these figures the change in the value of reduction of area over the period of time from the greatest softening effect to the so-called constant value is about 10-11%. Beyond the time T_c shown in the figures, the variation in this value is on the order of 1-2%. Further, in the period of time cited above, the value is more or less uniformly decreasing, whereas in the latter period the variation is plus and minus in nature. While the author's use of the term "constant reduction in area value" may be ill-advised in the narrow sense that it depends on a grain size equilibrium which probably cannot be attained in the length of time dealt with, still it seems that the use of such a sharply delineated characteristic behaviour in a practical way to measure the results of heat treatment is fully justified. The time cited as less than 135 seconds is, of course, a function of temperature, size of wire, and heating method, and must be considered in the light of these factors.

In several of the preliminary series of tests, it was found that method of tempering had no effect on the results as far as the effect of time in heating, already set up prior to the quench, was involved, nor did variations in temperature within reasonable limits. The factor of prime importance was time of tempering, and this was carefully considered, and of course, each piece in a series was given exactly the same tempering treatment. The fact that tempering temperature varied somewhat throughout the work explains the variation of physical properties from one series to another, but, in the author's opinion, this in no way invalidates the time value established through the plotted curve.

In regard to heating methods, flame radiation was not mentioned by name because none was present in the equipment used in these investigations. As

far as the absorption of radiant energy is concerned, it makes no difference whether the source is the flame or the furnace wall, or both together. If convection heating is present, as when the hot gases pass over and around the object being heated, the condition is then similar to that illustrated by Figure 3, in which case radiation and conduction were acting simultaneously. In the present case, it would be radiation and convection acting at the same time, and analysis would show that the amount of heat transferred in a given length of time by convection would be small in comparison with the amount transferred by radiation in the same time."

Chairman Hannon: Are there any other comments?

Mr. Donachie: I sort of planned to follow this thing. I am interested in these heatings and their effect on air-cooled specimens. What I am trying to arrive at is that I believe he referred to extra heating time being required under a certain set of conditions in respect to the function of air cooling for patenting. Is that right, that you felt there was an extra time required to get the patented results on air cooled specimens and extra time in the heating?

Mr. Tatnall: That was indicated by the results.

Mr. Donachie: Now, rather than heating time, it would seem to me that there was another factor there; I don't know whether you considered it or not; independent of the fundamental time required to completely austenitize the existing structure; we then have the effect of the extra time required for grain growth in the austenite, and since the size of the grain materially influences the effect of cooling rate, I would like to see if there is any correlation between the austenitic grain size and the ultimate end properties, which is a function of the grain size, as an influence on the cooling rate, since your products are a function of the cooling rate? I may not be putting that as clearly as I should, but I am trying. (Laughter)

Mr. Tatnall: Well, that phase of the study was not gone into in the present work. I am afraid I am not prepared to give you any answer. It would make a very interesting paper in itself.

Mr. Donachie: That has not been done on any air cooled basis, but in a specific case we ran into this condition on some very fine wires of a martinsitic structure. We were doing some work at a fixed temperature, and we could get by if we were down to .004, which was only a quarter of the volume. One would say that would be faster, but we could not increase the speed a foot when the size became very small.

Mr. Tatnall: As I said, that phase of the work was not gone into. No attempt was made to separate the two elements of time you mentioned; the attempt was rather to present an over-all picture.

Chairman Hannon: I noticed in one of the curves presented earlier in the paper, there was a difference in tensile properties reached in the case of those samples that touched the hearth as compared with those that did not. As I recall the curve, those samples which touched the hearth were of higher tensile property than those which did not. What is the explanation?

Mr. Tatnall: The explanation lies in the statement I made in the paper that the oil quenched samples were drawn at times and at temperatures which resulted in normal physical properties in the two series of samples. The series were not drawn at exactly the same temperature, they were drawn at the same time but the temperature was not exactly the same, because they were done some weeks apart, and that holds true in most of the curves. The actual tensile strength obtained, size for size, varies somewhat widely. For any one size — I am guessing a little bit on my figures, there is no effect on the time when you compare a series run on identical samples which are drawn so as to produce a tensile strength of 215 to 220,000 per square inch and a series drawn to produce a tensile strength on the order of 155 to 160,000. Does that answer your question?

Chairman Hannon: Yes, thank you.

Mr. H. N. Padowicz: There is usually a change in electrical resistance associated with the change in the structure of metals and alloys which occurs in heat treating and like processes. Electrical resistance can be readily evaluated in wire samples. I would like to ask the author if a method based on this change could be used in the determinations of the sort you have made to evaluate the physical properties of the samples after the noted heat treatments; and if it has not, what would be your comment on the use of such a method?

Mr. Tatnall: I would think that such a method would be extremely interesting to study in connection with this separation of time which has already been mentioned. It might be a good lead. On the other hand, I question whether it could be used to indicate the precise end result of the treatment. That is a snap reaction to your comment and I do not know. I have not given it too much consideration, that is, I have not given too much consideration to any method which might separate time and that sort of thing.

Mr. Padowicz: I was hoping that you had considered a such method. Long lengths of wire could be conveniently coiled into spirals and in that manner a very good average of the sample's properties could be obtained.

Mr. Tatnall: It could be handled very nicely; how it would fit in with the purpose, I am not so sure.

Chairman Hannon: Are there any other comments? We must proceed with the program.

PAPER: "PRODUCTION OF COMMERCIAL BRONZE SCREEN CLOTH WIRE"

We are going to swing into a non-ferrous session. The last paper this morning is "Production of Commercial Bronze Screen Cloth Wire" and the author is Mr. B. H. McGar, Assistant Director of Research of the Chase Brass and Copper Co., Inc.

(The paper presented by Mr. McGar was published in the October, 1941 issue of Wire and Wire Products.)

Chairman Hannon: Is there any discussion of this paper? Are there any questions? Mr. McGar referred to various methods, specifically the different machine equipment for fine wire drawing. I would like to ask why we make the rods in two different ways? Why do we hot roll some of the rods and why do we cold roll some of the rods? Is there any difference from the standpoint of cost, or is the reason, quality?

Mr. McGar: I think that question is best answered by saying that some mills do not have both types of equipment. Now a hot rolling mill for rods is quite expensive and unless you have a great volume to put through, it would not pay you to do it. Usually the people who have this type of hot rolling equipment use it comparatively a small amount of time on commercial bronze wire. Probably—I am just guessing now, but probably ninety percent of the time it is used for hot rolling copper, and so commercial bronze might be a little bit of a side issue, whereas a great many of the brass manufacturers might not be hot rolling copper but they have equipment for making the rods by cold rolling and drawing. Now as to the matter of cost and the price, I don't feel that I am in a position to give any information on that, because I don't know.

Chairman Hannon: How about the question of the quality of the final wire from the two different methods?

Mr. McGar: We have found no difference in the quality of the wire on five-sixteenths or quarter inch, providing they are properly annealed and handled as I have stated here this morning. We have made tensile studies and also micrographic studies, both on the rod as furnished to the wire drawer and also on the wire as finished ready for weaving, and to my knowledge there is very little if any difference between them.

Mr. Donachie: They say curiosity killed the cat, but I am curious about the apparent orderly disarray of reductions between die sizes.

Mr. McGar: Well, I think with a little more study that can be ironed out.

Mr. Donachie: The thing interests me. I know from my own experience in various lines that such systems are not unusual. We consider the ninety ten alloy relatively easy working and it is odd to see the reductions required so erratic.

Mr. McGar: I realize that, and I think that not only in our own plant but in several others, you will find out that that does exist, but there is no question that it can be ironed out in time.

A Member: I would like to elaborate more on Mr. Hannon's question. Usually much of this wire is subsequently insulated for use in electrical apparatus and the two methods of hot rolling are somewhat debatable in our industry. Outside of color, are there any differences in surface which actually do carry down to the final wire? More specifically, slivers or perhaps scale, which actually produce discontinuity in the surface?

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Mr. McGar: I do not think there is any question but what the cold rolled bronze presents a much smoother finish than the hot rolled rod. The hot rolled rod gives a comparatively rough finish and I think that if the material is to be finished up on a larger size, you might find evidence of rougher material. For the purpose intended, for screen cloth, I think the question of roughness might not have very much bearing, but in order to get the same type of rod for the hot rolled wire as one that is cold rolled and drawn, we certainly can see a difference in the quarter inch or five-sixteenths rod.

A Member: Are these differences subsequently carried down to the fine wire?

Mr. McGar: I have not much evidence of that, but I would not be surprised if that is the case.

Mr. Donachie: In the warp and in the shute do you have differing finishes for surface?

Mr. McGar: No.

Mr. Donachie: Do you find any marked difference between finish and ability to crimp?

Mr. McGar: Not that I know of.

Chairman Hannon: Is there any other comment? If not, with a word of appreciation to the speakers this morning and to the others who participated in the program earlier in the week, the 11th Annual Convention of the Wire Association will pass into history and this meeting stands adjourned.

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1942 Wire Association Convention to Be Held at Detroit

THE National Metal Congress and Exposition for 1942 will be held at Detroit, Michigan, the week of October 12, 1942, and the Wire Association will hold its annual Convention during the same week at the same place.

✦ ✦ ✦

THE Detroit-Leland Hotel will be the headquarters of the Wire Association.

✦ ✦ ✦

AS Chairman of the Program Committee for the 1942 Meeting, the President has appointed **Mr. N. F. Melville** of the Pittsburgh Steel Company, Grant Building, Pittsburgh, Pa.

✦ ✦ ✦

ANY members of the Association having suggestions or desiring to contribute papers for this year's Convention are invited to contact Mr. Melville.

For Information Regarding The Wire Association Address

Richard E. Brown, Secretary
Stamford Trust Co. Bldg.,
300 Main St. Stamford, Conn.

Outstanding Personalities of the Wire Industry

R. V. Mann, General Sales Manager, Carpenter Steel Company

R. V. MANN, assistant to the president of the Carpenter Steel Company, has been named general sales manager.

✦ ✦ ✦

MR. MANN, a graduate of Stevens Institute of Technology, joined the Carpenter organization in 1911. After six years in various departments of the mill, he resigned in 1917 to enter the United States Army. Following two years of service as a Captain in the Ordnance Department, he returned to civilian life as district sales manager for Peerless Drawn Steel Company at Cincinnati, and later at Chicago.

✦ ✦ ✦

IN 1925, he returned to Carpenter as assistant to the president, in which capacity he supervised the sales of stainless steel.

✦ ✦ ✦

Carboloy Personnel Changes

CENTRALIZATION of its sales engineering department under **K. R. Beardslee,** Sales Manager, has been announced by **W. G. Robbins,** President, Carboloy Company, Inc., Detroit. Simultaneously two posts of Assistant Sales Manager in charge of this activity have been created, and **Martin Muhling,** former Special Engineering Executive and **Earl Glen,** formerly Carboloy Pittsburgh representative, have been appointed to the new posts.

✦ ✦ ✦

A. H. GODFREY, formerly Cleveland District Manager for Carboloy Company has been appointed Factory Manager of the Detroit plant, Mr. Godfrey being succeeded in Cleveland by **W. S. Baker,** formerly with the Carboloy Chicago office.

✦ ✦ ✦

R. R. PRESTON, formerly superintendent of the wire mill at Page Steel and Wire Company succeeds Mr. Glen in Pittsburgh.

W. G. Hume, Consultant on Cold-Finished Bars and Wire Products Office of Production Management

W. G. HUME, general manager of sales of the Pittsburgh Steel Co., has been called to Washington by the Office of Production Management to serve as consultant on cold-finished bars, rods, wire and wire products.

✦ ✦ ✦

MR. HUME, who previous to his joining the Pittsburgh Steel Company several years ago, was formerly in sales executive capacities with Northwestern Steel & Wire Company, Sterling, Ill., and Keystone Steel & Wire Company, Peoria, Ill. His 30 years' experience in the steel industry has been largely concerned with bars, rods, wire and wire products.

✦ ✦ ✦

Eugene King, Manager Cleveland Branch, John Roebling's Sons Co.

EUGENE KING, formerly assistant manager, has been named manager of the Cleveland branch of John A. Roebling's Sons Co., Trenton, N. J., replacing **Raymond R. Newell** who has retired after having been in charge of the Cleveland organization since 1911.

✦ ✦ ✦

MR. KING was first employed by the Roebling company in 1917 and in 1926 became salesman in charge of the Detroit area. He was appointed assistant manager of the Cleveland branch in 1941.

✦ ✦ ✦

J. W. McNairy, Asst. Mgr., Bridgeport Wks. of General Electric Company

J. W. McNAIRY, who has been associated with the General Electric Co. for 24 years, has been appointed assistant manager of the Bridgeport works of the General Electric Co. Mr. McNairy was graduated from the North Carolina State College in 1917 with a degree of B. S. in electrical engineering and immediately afterward entered the G-E student engineering course at Schenectady.

✦ ✦ ✦

HE first became associated with the company's railway department in 1920 and in 1928 was made assistant design-engineer for the control division of the transportation department. He held this position until he was transferred to Bridgeport in 1940 to become assistant to the manager in charge of engineering.

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American Steel & Wire Announces Personnel Changes

THREE changes in its executive plant personnel in the Cleveland district have been announced by American Steel & Wire Company, subsidiary of U. S. Steel Corporation.

✦ ✦ ✦

E. F. BROWN has been appointed general superintendent of the American, Consolidated & Newbranch of John A. Roebling's Sons **Helm** has been made superintendent of American Works and **H. R. Patterson** has been named superintendent at Consolidated Works.

✦ ✦ ✦

MR. BROWN has been associated continuously with the Wire Company since October, 1904, when he began as a draftsman at American Works.

✦ ✦ ✦

MR. HELM started with American Steel & Wire in September, 1913, as assistant metallurgist at South Works in Worcester, Mass.

✦ ✦ ✦

MR. PATTERSON became associated with the Trenton Iron Company, a predecessor company of American Steel & Wire Company, in May, 1907, as foreman of the testing department.

✦ ✦ ✦

Edward M. Murphy, Division Metallurgist, American Steel & Wire Company

EDWARD M. MURPHY has been appointed division metallurgist, cold drawn, of American Steel

(*Please turn to Page 71*)

STATISTICS --- OCTOBER, 1941

PRODUCTION FOR SALE OF IRON AND STEEL PRODUCTS

AMERICAN IRON AND STEEL INSTITUTE
Capacity and Production for Sale of Iron and Steel Products

October - 1941
PERIOD

		Number of companies	Items	Annual Capacity Net tons	Production for Sale—Net Tons: Current Month: Total	Current Month: Per cent of capacity	Current Month: Shipments: Export	Current Month: Shipments: To members of the industry for conversion into further finished products	Year to Date: Total	Year to Date: Per Cent of capacity	Year to Date: Shipments: Export	Year to Date: Shipments: To members of the industry for conversion into further finished products
Steel Products	Ingots, blooms, billets, slabs, sheet bars, etc.	42	1	xxxxxxx	668,144	xxx	216,266	181,684	5,736,350	xxx	1,621,225	1,735,666
	Heavy structural shapes	9	2	5,248,400	406,528	91.2	13,910	xxxxxxx	3,841,278	87.9	147,805	xxxxxxx
	Steel piling	4	3	422,000	28,121	78.4	2,013	xxxxxxx	294,856	83.9	28,568	xxxxxxx
	Plates—Sheared and Universal	20	4	5,624,360	592,822	124.1	26,085	5,351	4,819,712	102.9	281,836	34,716
	Skelp	8	5	xxxxxxx	83,716	xxx	8,384	43,078	848,478	xxx	133,780	357,121
	Rails—Standard (over 60 lbs.)	4	6	3,613,600	140,963	45.9	11,925	xxxxxxx	1,454,613	48.3	61,229	xxxxxxx
	Light (60 lbs. and under)	6	7	302,800	16,027	62.3	2,343	xxxxxxx	146,803	58.2	50,741	xxxxxxx
	All other (Incl. girder, guard, etc.)	2	8	102,000	3,577	41.3	456	xxxxxxx	22,823	26.9	3,007	xxxxxxx
	Splice bar and tie plates	14	9	1,299,600	50,661	45.9	1,254	xxxxxxx	586,811	54.2	12,702	xxxxxxx
	Bars—Merchant	41	10	xxxxxxx	563,212	xxx	24,295	60,103	5,330,571	xxx	385,224	631,105
	Concrete reinforcing—New billet	19	11	xxxxxxx	167,705	xxx	17,793	xxxxxxx	1,345,555	xxx	176,259	xxxxxxx
	Rerolling	19	12	xxxxxxx	30,690	xxx	2,139	xxxxxxx	209,240	xxx	13,887	xxxxxxx
	Cold finished—Carbon	25	13	xxxxxxx	107,102	xxx	2,622	xxxxxxx	1,050,944	xxx	21,277	xxxxxxx
	Alloy—Hot rolled	18	14	xxxxxxx	155,737	xxx	3,152	21,798	1,569,082	xxx	119,526	230,752
	Cold finished	19	15	xxxxxxx	21,805	xxx	1,923	xxxxxxx	159,642	xxx	25,173	xxxxxxx
	Hoops and baling bands	5	16	xxxxxxx	9,641	xxx	510	xxxxxxx	98,346	xxx	3,519	xxxxxxx
	TOTAL BARS	65	17	13,317,725	1,055,892	93.3	52,434	81,901	9,763,380	88.0	744,865	861,857
	Tool steel bars (rolled and forged)	17	18	180,470	14,749	96.2	616	xxxxxxx	126,218	84.0	6,339	xxxxxxx
	Pipe and tube—B. W	16	19	2,242,040	172,352	90.5	7,681	xxxxxxx	1,466,497	78.5	98,476	xxxxxxx
	L. W	8	20	895,260	40,997	53.9	1,466	xxxxxxx	413,829	55.5	24,479	xxxxxxx
	Electric weld	6	21	551,020	48,582	103.8	4,678	xxxxxxx	455,845	99.3	27,468	xxxxxxx
	Seamless	15	22	2,997,160	221,404	86.9	15,308	xxxxxxx	1,830,815	73.3	158,252	xxxxxxx
	Conduit	8	23	174,140	15,619	105.6	524	xxxxxxx	134,502	92.7	4,038	xxxxxxx
	Mechanical Tubing	11	24	393,570	32,056	95.9	2,882	xxxxxxx	287,886	87.8	21,514	xxxxxxx
	Wire rods	22	25	xxxxxxx	117,263	xxx	15,311	17,872	1,262,510	xxx	165,279	210,138
	Wire—Drawn	39	26	2,230,290	211,640	111.7	9,291	1,614	1,897,984	102.2	118,652	18,823
	Nails and staples	18	27	1,153,930	66,027	67.3	3,935	xxxxxxx	664,929	69.2	57,216	xxxxxxx
	Barbed and twisted	16	28	474,210	24,728	61.4	12,223	xxxxxxx	230,607	58.4	58,914	xxxxxxx
	Woven wire fence	16	29	777,785	22,915	34.7	82	xxxxxxx	259,420	40.0	1,746	xxxxxxx
	Bale ties	11	30	110,970	7,134	75.7	124	xxxxxxx	70,651	76.4	295	xxxxxxx
	All other wire products	7	31	41,380	1,958	55.7	-	xxxxxxx	17,845	51.8	3	xxxxxxx
	Fence posts	12	32	122,165	4,588	44.2	188	xxxxxxx	59,068	58.0	982	xxxxxxx
	Black plate	11	33	340,030	45,578	157.8	5,935	-	370,084	130.7	34,600	43
	Tin plate—Hot rolled	7	34	515,620	44,067	100.6	18,028	xxxxxxx	294,118	68.5	52,596	xxxxxxx
	Cold reduced	11	35	3,542,040	298,252	99.1	40,920	xxxxxxx	2,582,343	87.5	246,623	xxxxxxx
	Sheets—Hot rolled	32	36	xxxxxxx	647,245	xxx	27,388	15,880	6,328,654	xxx	260,552	177,462
	Galvanized	16	37	xxxxxxx	123,957	xxx	5,777	xxxxxxx	1,416,086	xxx	91,149	xxxxxxx
	Cold rolled	18	38	xxxxxxx	234,481	xxx	11,621	xxxxxxx	2,596,561	xxx	67,284	xxxxxxx
	All other	13	39	xxxxxxx	62,706	xxx	2,102	xxxxxxx	649,619	xxx	19,752	xxxxxxx
	TOTAL SHEETS	32	40	13,369,740	1,068,389	94.1	46,888	15,880	10,990,920	98.7	438,787	177,462
	Strip—Hot rolled	24	41	3,285,430	155,897	55.9	5,345	20,289	1,697,633	62.0	63,835	210,647
	Cold rolled	38	42	1,525,510	109,658	84.6	3,841	xxxxxxx	1,092,364	86.0	21,721	xxxxxxx
	Wheels (car, rolled steel)	5	43	422,820	26,769	74.5	695	xxxxxxx	217,178	61.7	2,153	xxxxxxx
	Axles	6	44	480,350	20,629	50.5	654	xxxxxxx	160,761	40.2	3,205	xxxxxxx
	Track spikes	11	45	325,770	14,958	54.0	397	xxxxxxx	143,637	52.9	3,205	xxxxxxx
	All other	8	46	96,600	5,839	71.1	-	xxxxxxx	41,700	51.8	79	xxxxxxx
	TOTAL STEEL PRODUCTS	163	47	xxxxxxx	5,838,499	xxx	532,082	367,669	54,284,448	xxx	4,696,165	3,606,473
	Pig iron, ferro manganese and spiegel	29	48	xxxxxxx	694,199	xxx	14,438	292,521	6,711,406	xxx	448,993	2,226,457
	Ingot moulds	4	49	xxxxxxx	62,629	xxx	459	xxxxxxx	625,397	xxx	3,707	xxxxxxx
Iron Products	Bars	13	50	175,915	9,408	62.9	184	551	83,402	56.9	990	4,563
	Pipe and tubes	3	51	109,300	6,682	72.0	185	xxxxxxx	57,895	63.6	2,316	xxxxxxx
	All other	1	52	56,000	2,089	43.9	438	-	16,381	35.1	3,404	-
	TOTAL IRON PRODUCTS (ITEMS 50 to 52)	14	53	276,715	18,179	77.3	807	551	157,678	68.4	6,710	4,563

Total Number of Companies Included - 186

The estimated average yield of products for sale from ingots produced by the companies included above is 71.1 *%, which applied to their total ingot capacity equals* 59,640,600 *net tons of finished rolled products. Production for sale, less shipments to members of the industry for further conversion, related to the estimated yield is as follows:*

Current month 5,470,830 *N. T.:* 108.0 *%*
Year to date 50,677,975 *N. T.:* 102.0 *%*

During 1940, the Companies included above represented 97.9% of the total output of Finished Rolled Products.

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Exports and Imports of Wire

Iron and Steel Imports Show Increase in August

IRON and steel imports rose to 1,975 tons valued at $462,232 in August. This figure represents a slight increase over July imports of 1,631 tons valued at $219,276 but is below August 1940 imports of 2,089 tons valued at $516,187.

✦ ✦ ✦

CUMULATIVE 8 months imports stand at 14,314 tons valued at $2,429,584 compared with imports of 44,267 tons valued at $5,367,590 for the same period of 1940.

✦ ✦ ✦

RAILS and track material was, in point of tonnage, the most important item imported with 607 tons, all of which came from Canada. Flat wire and steel strips, 493 tons, all from Sweden, and ferromanganese, 385 tons, all from Canada, ranked second and third, respectively.

CANADA was the chief supplier with 1,390 tons, followed by Sweden with 517 tons. The United Kingdom and Norway supplied the remainder.

✦ ✦ ✦

REFLECTING the increasing shortage of iron and steel scrap in this country, imports of that material rose 7,000 tons over the July figure to total 16,405 tons in August.

✦ ✦ ✦

CUBA, sending 8,803 tons, and Canada, sending 5,523 tons, were the chief suppliers. Other receipts were from Netherlands West Indies, Surinam, Haiti, Mexico, Turkey and Russia.

✦ ✦ ✦

Exports of Iron and Steel Advance In September

CONTINUING the trend begun in July, exports of iron and steel products again increased in September, totaling 641,094 gross tons valued at $38,946,334. Representing a gain of 4 percent over August exports of 617,477 tons valued at $44,375,965, the figure is still well below September 1940 exports of 965,444 tons valued at $50,630,630.

✦ ✦ ✦

CUMULATIVE 9-months exports for 1941 at 4,753,255 tons valued at $341,379,998 are likewise below the 5,487,012 tons valued at $341,841,419 exported during the comparable period of 1940.

✦ ✦ ✦

NONALLOY ingots, blooms, etc., formed, in point of tonnage, the most important item exported in September, the total of 328,662 tons representing an increase of 51 percent over August exports. Nonalloy "black" (ungalvanized) sheets ranked second with 27,889 tons exported, followed by tin plate and taggers' tin, 27,025 tons, and pig iron, 26,331 tons.

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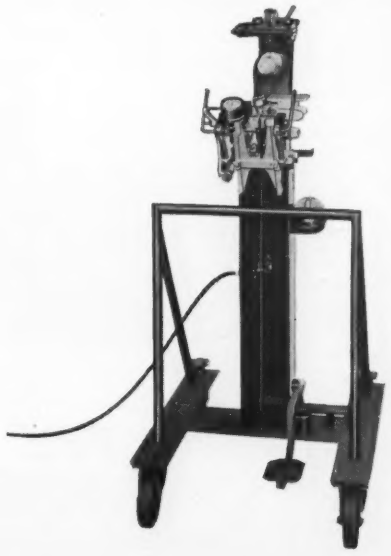

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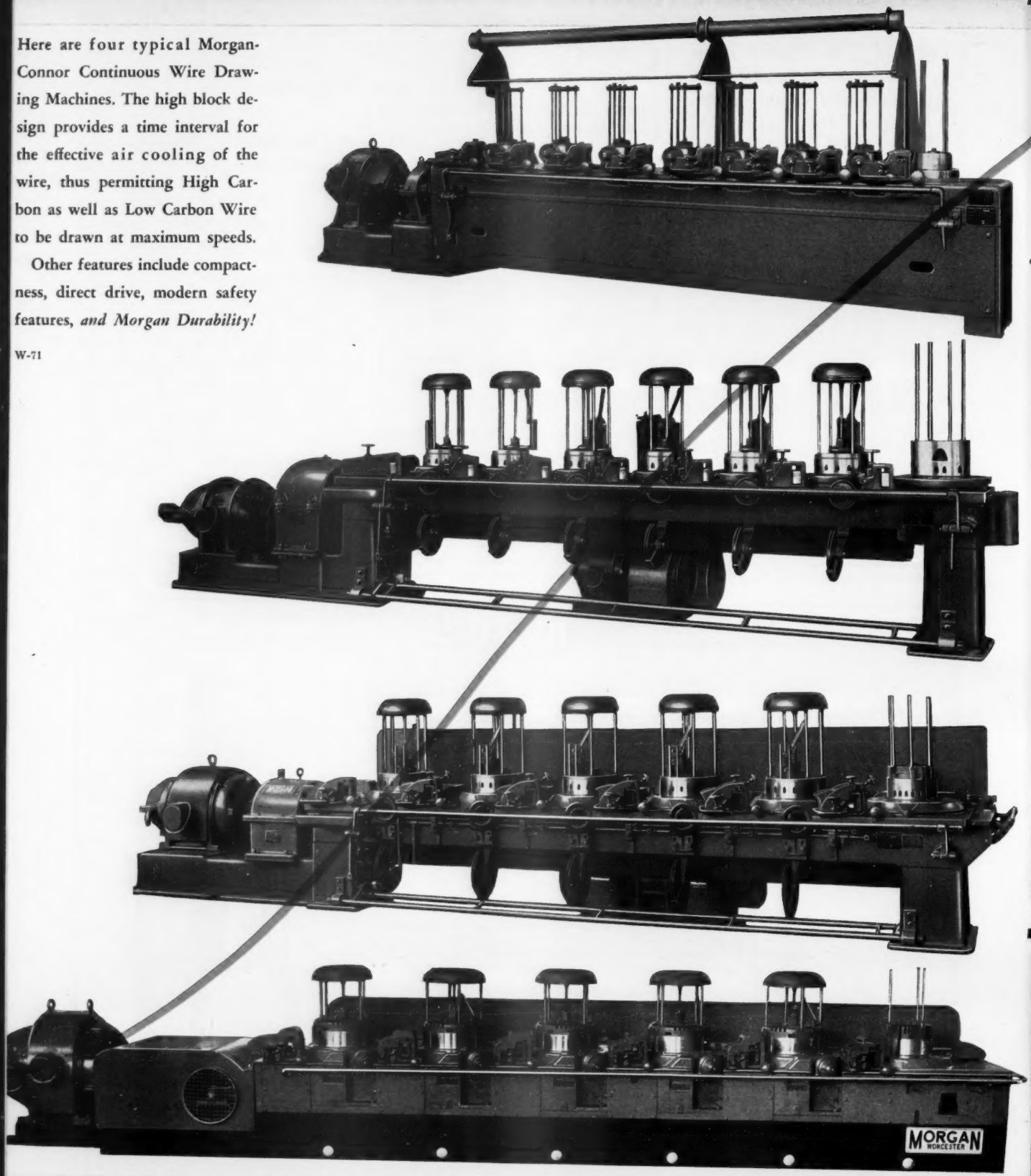

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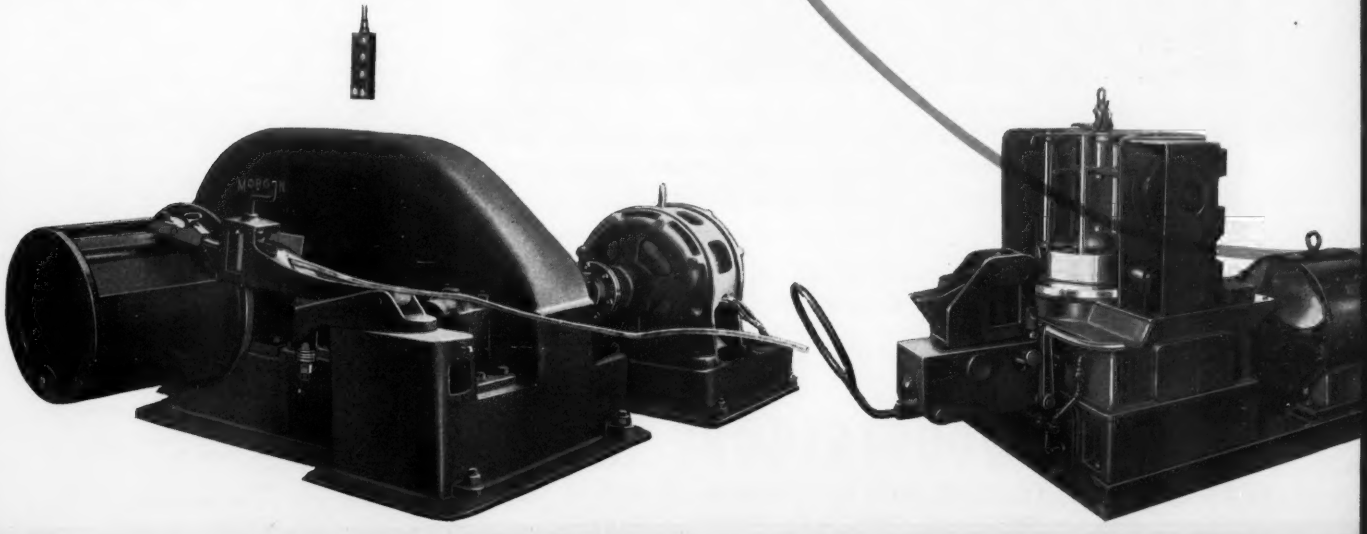
This equipment is proving itself in the present Emergency. We're busy of course—but get in touch with us: we will do everything we can to help you in your present National Defense work—*and in your own Defense work later on.*

★ **PRODUCTION FACTOR**

Like the Factor of Safety, the production capacity of Morgan Machines has always been well above rated capacity.

Morgan Horizontal Bull Block, Type 105, handles cold drawn round stock one inch or less diameter and equivalent sections in other shapes. One outstanding feature is the speed with which a finished bundle can be stripped from the horizontal block. Smooth, quiet and dependable. High carbon steel gears with cut teeth run in a bath of oil. Shaft bearings are roller type throughout.

Morgan Vertical Spindle Wire Blocks offer important features: Single and double deck blocks; interchangeable blocks; die boxes fully adjustable for horizontal or vertical cast and equipped to receive all common sizes of die holders. Each machine is unit powered, and driven by combination spiral bevel and helical gears that give high efficiency at all ratios. Air-cooled blocks embody new patented fin-type construction, resulting in highest efficiency. Modern safety devices.



MORGAN WORCESTER ENGINEERS AND MANUFACTURERS

WORCESTER, MASSACHUSETTS

Exports and Imports

(*Continued from Page 47*)

AT 65,486 tons valued at $1,214,548, exports of scrap in September decreased from the 80,255 tons valued at $1,564,209 recorded in August. Exports in September 1940, the last full month before the export of scrap became subject to license, had amounted to 255,608 tons valued at $4,437,019.

✦ ✦ ✦

CUMULATIVE 9-month exports for 1941 totaled 621,526 tons valued at $12,050,641, compared with the 2,417,534 tons valued at $41,066,454 exported during the comparable period of 1940.

✦ ✦ ✦

IRON and steel scrap accounted for 64,548 tons of the total exported in September, this figure being further broken down as follows: No. 1 heavy melting, 12,764 tons; No. 2 heavy melting, 28,163 tons; baled and bundled, 9,287 tons; cast and burnt, 734 tons; and other scrap, 13,600 tons.

Introducing! **MONOLITHIC**

Acid Tank Construction

PATENT PENDING

Our new MONOLITHIC Construction as illustrated in above pickling tank installation offers maximum wall strength with all joints broken and staggered, requiring less jointing material, and is most economical for high temperature pickling.

The specially designed, new-shaped TORONTO Acid Brick is here combined with our well known Acid Proof Cement Plasul BASOLIT.

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Steel Co. of Canada, Ltd.,
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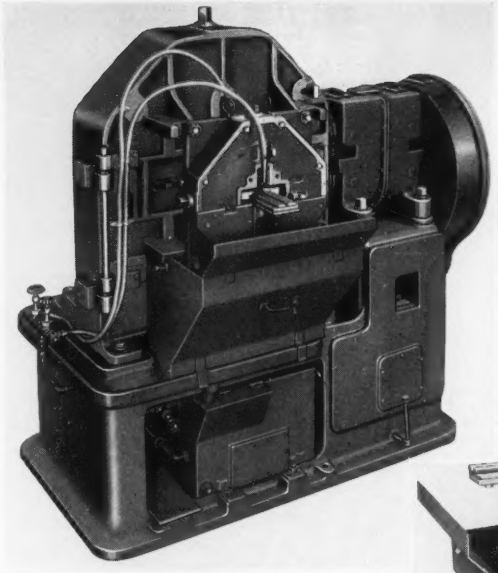
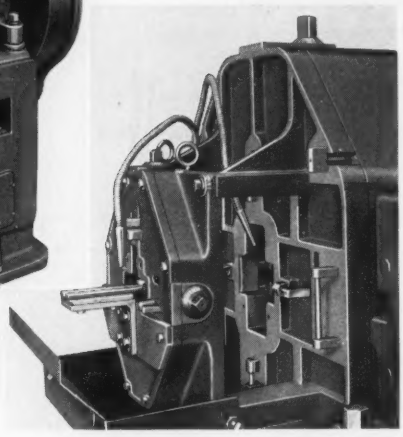
(Please turn to Page 52)



Front and side view plain type Turks Heads, tandem mounted. (Universal type units also available).



A NEW

Tandem Turks Head Combination

combining friction and power driven units - - -

The Friction Roll Turks Head makes the first reduction, the power driven unit the final reduction to size or special shape required.

Four advantages of double mounting:

1. Number of passes is reduced — time is saved;
2. Final accuracy limits specified are more closely held;
3. Reduction speed increased — roll maintenance decreased;
4. No auxiliary drawing equipment is needed — power driven Turks Head draws wire through the friction rolls.

As shown, coolant is pumped to both units from integral circulating coolant system in base of machine.

If this tandem unit seems applicable to your work send us details — material, reduction, size, shape, etc. — We will forward complete recommendations promptly.

OTHER "STANDARD" EQUIPMENT

TURKS HEADS

Adjustable draw plates — accepted by wire trade as accurate efficient means of producing rectangular and special shapes. Available with friction or power driven rolls. Catalog TH.

DRAW BENCHES

8 sizes, 2 general types. Machines are of one-man type with all controls at die end. Catalog DB.

ROLLING MILLS—STRIP AND WIRE

Roller bearing and plain bearing mills; many regular sizes or made to suit user's specific needs. Write fully.

SWAGING MACHINES

For reducing diameter of tubular and solid bar stock into cylindrical, conical, or "necked" shapes. Capacities from ½" tube, ¼" solid to 6" tube or 3¾" solid. Catalog SM.

PRESSES

Hand screw and foot presses. Power presses with rigid or inclinable beds, in single slide or double plunger transfer types. Catalogs SP, FP, PP.

DROP HAMMERS

9 sizes, ram weights from 50 to 1200 lbs.; anvils from ½ to 11 tons. Massive construction, adjustable stroke. Catalog DH.

SCRAP BUNDLERS

Wind stringy scrap from slitters into compact roll weighing about 300 lbs. 12 Bundles per hour.

IT'S **STANDARD** PRACTICE

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ANNUAL MEDAL AWARD of the WIRE ASSOCIATION

FOR THE MOST MERITORIOUS PAPER ON WIRE MANUFACTURE OR FABRICATION DURING THE YEAR

— BY A MEMBER OF THE WIRE ASSOCIATION —

✦ ✦ ✦

ALL members of the Wire Association are cordially invited to submit technical papers either for publication in "WIRE & WIRE PRODUCTS" during the year or for presentation before the Annual Wire Association Convention.

✦ ✦ ✦

AN annual medal will be awarded in each of the two major divisions of the activities of the Association, to the papers coming nearest to the requirement set forth above.

✦ ✦ ✦

CONSIDERATION for the Medal Awards is not limited to the papers presented at the Annual Meeting, but is given to all papers submitted by members and published in "WIRE & WIRE PRODUCTS" during the year.

✦ ✦ ✦

ADDITIONAL information may be obtained by addressing:

✦ ✦ ✦

SELECTION of papers to be presented at the Annual Convention rests in the hands of the Joint Programme Committee and the Board of Directors of the Wire Association.

✦ ✦ ✦

ALL papers submitted become the property of the Wire Association and the Board of Directors constitutes the Committee on Awards.

✦ ✦ ✦

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SELLEN, C. A., Metallurgist,
Eaton Mfg. Company,
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SHEARER, ROBERT G., Wire Sales Dept.,
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SHILLING, BILL, Sales Engr.,
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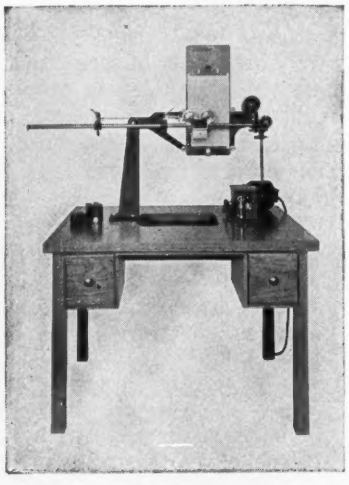
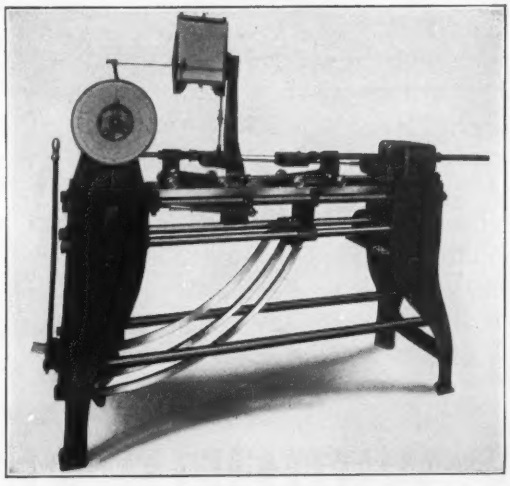
(Please turn to Page 54)

SCOTT TESTERS



Model IP-2
Maximum capacity
2 pounds



Model Q-5
Maximum capacity
2000 pounds

AUTOGRAPHIC recording tensile testing machines built on either the constant specimen rate of load or constant speed of pull principles. Made in a wide range of models and capacities with high and low stretch magnification recorders - for Wire, Sheet Metals, Rubber, Textiles, Paper, etc.

HENRY L. SCOTT CO.

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(Continued from Page 53)

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WIRE & WIRE PRODUCTS,
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Bristol, Rhode Island

TATNALL, R. R., Met. Engr.,
Wickwire Spencer Steel Co.,
Worcester, Mass.

THOMPSON, W. PAUL, Met.,
Townsend Company,
New Brighton, Pa.

TIMBERS, H. H., Contract License Mgr.,
Western Electric Co.,
New York, N. Y.

TIMMERMAN, E. D., Gen. Supt.,
The Steel Co. of Canada, Ltd.,
Montreal, P. Q., Canada

TOPPING, C. E., Engr.,
Commonwealth & Southern Corp.,
Jackson, Michigan

TRAUTMAN, O. C., Vice Pres.,
Trauwood Engineering Co.,
Cleveland, Ohio

VAN VALKENBURG, F. S., Engr. Dept.,
Waterbury-Farrel Fdry & Mach. Co.
Waterbury, Conn.

VAUGHN, J. A., Secy.,
The Vaughn Machinery Co.,
Cuyahoga Falls, Ohio

VAUGHN, L. A., President,
The Vaughn Machinery Co.,
Cuyahoga Falls, Ohio

WARD, C. T., Supt. Rod & Wire,
Bethlehem Steel Co.,
Johnstown, Pa.

WIEKEL, G. A., Rep.,
American Chemical Paint Co.,
Chicago, Illinois

WELSH, J. ALAN, Firthaloy Div.,
Firth-Sterling Steel Co.,
Hartford, Conn.

WESTERMAN, BERNARD, Met.,
Page Steel & Wire Div.,
American Chain & Cable Co.,
Monessen, Pa.

WESTPHAL, F A., Supt. Wire Mills,
Sheffield Steel Corp.,
Kansas City, Mo.

WINKLER, L. H., Met. Engr.,
Bethlehem Steel Co.,
Bethlehem, Pa.

WOODBURY, RICHARD T., Fore.,
Testing & Finishing,
American Steel & Wire Co.,
Trenton, N. J.

WOODFORD, F. M., West. Mgr.,
Tungsten Elec. Corp.,
Cleveland, Ohio.

WOODHEAD, R. R.,
John A. Manning Paper Co.,
Troy, New York.

WYATT, K. S., Cable Engr.,
Phelps Dodge Copper Products Corp.,
New York, N. Y.

ZAPP, A. R., Mgr., Firthaloy Div.,
Firth-Sterling Steel Co.,
McKeesport, Pa.

Several in attendance failed to register so if the name you are looking for is not on this list, that is the reason.

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has been specializing in the production of cutting and drawing lubricants for practically half a century. Such a background has, as a consequence, brought us into direct contact with the most diversified requirements in our manufacture of drawing compounds to meet the varied demands of the drawing industry.

Have You A Drawing Problem?

If you have a drawing problem or if you are desirous of improving your present procedure may we have an opportunity to cooperate with you. Our past experience and constant development of lubricants to meet the ever increasing demands of the drawing trades should be of marked assistance. Moreover we would like to work with you and feel confident that such an arrangement would prove mutually beneficial. May we have this opportunity? Our representatives are most willing and able to assist and their time and ability plus the whole-hearted cooperation and experience of our manufacturing department is yours for the asking. Write us about it—won't you?

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Wire Drawing Powder; Water Soluble Lubricants for Continuous Machines; Lubricants for Cold Header Stock; Extreme Pressure Bull Block Greases; Single and Multiple Hole Bright Wire Greases; Drawing Oils, etc.

Brazing Technique for Carbide Tools

WITH the tremendous increase in usage of cemented carbide tools for defense production, many manufacturers are beginning to produce their own cutting tools by brazing standard Carboloy tips to shanks milled in their own tool department. To assist such manufacturers, the following torch brazing procedure is being recommended by the Carboloy Company, Inc.:

✦ ✦ ✦

A "SANDWICH" braze should be used for tools with tips of ¾ inch or more, and also for irregularly shaped tips. This type of braze differs from the ordinary braze, mainly in that a constantan sheet is inserted between double layers of Easy-Flo #3 and Handy-Flux.

✦ ✦ ✦

THE "sandwich" braze is also recommended when tools are produced from tips of such grades

as 999, or 881, or 78, regardless of the tip size used.

✦ ✦ ✦

IN applying heat, the torch should be adjusted to avoid oxidation. To assure uniformity of heat distribution beneath the tip, the torch should be applied until the Easy-Flo #3 is molten, flows freely, and wets the tip. The flame should be kept moving back and forth to avoid burning the steel. The tip should be held in place with a steel rod for a short period to allow braze to set.

✦ ✦ ✦

WHEN brazing shanks ¾ inch square or larger, it is desirable to equalize the temperature by preheating the shank. This is best done by applying the flame to the bottom and sides of the shank and finally to the tip to complete the braze.

✦ ✦ ✦

WHEN it is necessary, due to tip location, to fill in crevices or build up a brazed backing on the back side of the tip, this work should be done during the brazing cycle — by applying the torch on top of the tip, using Easy-Flo #3 rod. ✦ ✦ ✦

DUE to the difference in the rate of contraction between cemented carbides and steel, it is necessary to cool the tool slowly to avoid cracking the tip. This may be done by burying it in powdered charcoal, graphite, asbestos, mica, or lime. Tools should never be cooled by quenching.

✦ ✦ ✦

Corrective Eye Protection for Workers With Defective Vision

MANY of America's 13,000,000 industrial workers are visually deficient and should wear safety goggles fitted with hardened prescription lenses which not only correct but also protect vision so that maximum safety and working efficiency are assured. Available statistics reveal that only 50 per cent of workers who need corrective glasses actually possess them.

✦ ✦ ✦

IN view of the tremendous importance of maintaining the health of our skilled as well as unskilled workers at the highest peak of efficiency, AMERICAN OPTICAL COMPANY has made available seven different styles of safety goggles fitted with Super Armorplate lenses which can be ground to prescription. Both eye-correction as well as eye-protection for industrial workers with defective vision are thereby provided.

✦ ✦ ✦

THESE protective - corrective safety goggles, according to the announcement, include spectacle and side-shield types for different kinds of eye hazards, and the extra-strong, hardened Super Armorplate lenses can be obtained in either clear white or glare protection glass. Employers desiring information on the subject may obtain it by addressing the AMERICAN OPTICAL COMPANY, SOUTHBRIDGE, MASS.

If You Are Not A Member Of
The Wire Association —
Now Is A Good Time To Join!

A wire machine is only as good as its dies. Dies control the amount of wire produced, the accuracy of size, the quality of finish and—to an important degree—the physical properties of the wire. Therefore, no buying policy could be more "penny wise and pound foolish" than that of buying drawing dies on a price basis. The difference between TECO CARBIDE DIES and "second-best" dies may be only pennies in price but it may be tons in production.

Tungsten Electric Corporation manufactures wire and bar dies, tubing dies, extruding dies, sizing dies . . . also carbide blanks, tools, bits and special tools.

Write or telephone and one of our engineers will be glad to discuss your requirements with you.

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564 39th Street • • • Union City, N. J.
Branch Office: 2906 Euclid Avenue, Cleveland, Ohio
Pioneers in Tungsten Carbides for Over a Quarter Century

The Shape of Things to Come

(*Continued from Page 27*)

and easy to forget, and confident that they will one day come up again for discussion, I intend to set down here for permanent record, a few of the basic facts.

✦ ✦ ✦

1. Reactive drawing is the name applied to wire drawing in which a predetermined back-pull is applied by means of differential gear mechanism to the wire approaching the die. Back-pull may be applied by snubbers, brakes, underspeeded capstans, etc., and it will affect physical properties, but only reactive drawing actually realizes the potential power saving, and keeps the amount of back-pull in delicate and automatic control.

2. All differential gear sets, regardless of gear proportion, have a 2 to 1 ratio.

3. In reactive drawing the pull-block is not connected direct to the spindle. It's speed, relative to spindle speed, varies with the reduction in the die, never reaching 100% nor dropping as low as 50%.

4. In reactive drawing there is an increased die pull, but the hold-back block, driven by the running strand, feeds torque back to the spindle so that there is a net power saving. This saving arises from a large reduction in die friction, and is therefore greater in light than in heavy drafts.

5. When hold-back and pull-block are of equal diameter, back pull is equal to die pressure. Their total appears as die pull; this is greater than in orthodox drawing, but the power absorbed is a function not of die pull, but of die pressure.

6. Since die pull is increased, a draft which is as heavy as the stock will stand in orthodox drawing, cannot be drawn reactively.

7. A reactive block can form a unit of a continuous machine of the Connor storage type or of the motor-driven dancing rheostat type, but not of the slip type.

✦ ✦ ✦

ENOUGH has been recorded and published about the effects of back stressing to make it unnecessary for me to dwell on it further. I nominate reactive drawing as our future course and predict that we shall soon be at it.

✦ ✦ ✦

Heat Treating

HEAT treating of wire in its early days was of the most informal nature, generally consisting in throwing the wire into a bonfire, although fine wire in comparatively early times began to be sealed up in pots. Wire enterprises were so small that the advice of one early writer, that annealing be done in the firebox of a baker's oven after the last batch of bread had been drawn, was not too far off the mark. Of course scale was of no particular consequence when no acid was used, nor can you decarburize wrought iron.

✦ ✦ ✦

WHEN our generation took over, the old open muffle was a prime favorite because of its speed and low fuel consumption. Some beautiful clean work was done by the artists of the period, and I recall #14 being muffled as standard practice. Our pots in those days were at least two inches thick, generally weighing more than the charge. Sometimes they were left permanently in place for fear that the crane would pull the building down, and then the cycle was upwards of 48 hours. Coal firing was almost universal, the foreman's eye measured the heat, and atmosphere was just a word in the dictionary. Still there was some nice bright and blue annealing done in those days.

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Greater service from a new All Welded Steel Take Off Reel designed to meet present day requirements.

Usual maintenance expense eliminated by adoption of this new design wherein all parts are welded into one homogeneous unit.

Reel sides are embossed with radial reinforcing ribs for increased rigidity with rolled edges for additional strength and to facilitate handling.

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Complete line of spools and reels for both processing and shipping all kinds of bare and insulated wires and cables. (Send for Catalogue W-104)

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James Day (Machinery), Ltd., The Grange, Whetstone, Nr. Leicester, England.

THE achievements of our time have been these: various schemes to permit the use of thin-walled pots, the general adoption of fluid fuels, pyrometers, zone control, and pot atmospheres. There is no point in discussing them other than to remind ourselves that there is still much to learn, particularly about the behavior of carbon. We have just reached the stage where we know there is no close connection between oxidation and decarburization. We are beginning to perceive that moving atmospheres are quite unlike stagnant atmospheres, and that given atmospheres react differently with the charge in each temperature range.

✦ ✦ ✦

IN batch annealing our temperature control is now adequate, and oxidation is under excellent control. The last point for attack is decarburization. We have practically acquired the ability to prevent further loss of carbon, but we are still troubled by the loss which we inherit from casting and rolling operations beyond our control. Now there is some promise that even this loss may be brought under control. A process now moving slowly toward commercial acceptance has worked out well in similar fields and is now being slowly brought into line for wire rods in the medium carbon range, the goal being to build back both totally and partially decarburized zones to the original carbon content and no further. The investigations of Johansson and Von-Seth, LeChatelier, Schenck and others foreshadow success, provided the control of the atmosphere is not too intricate a job.

✦ ✦ ✦

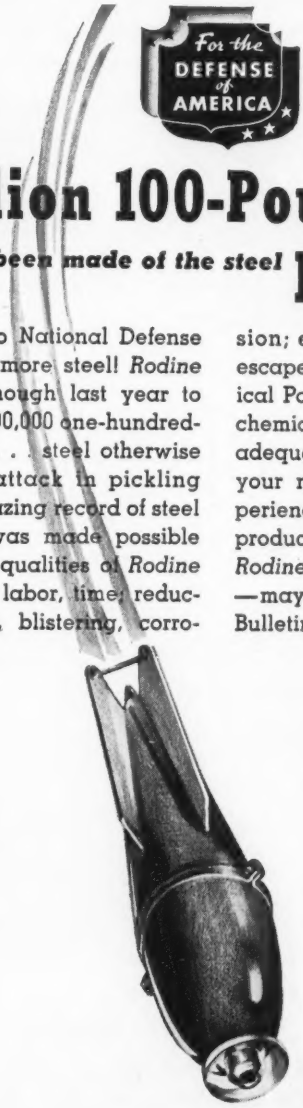
STRAND treatment of wire began in the decade 1850-1860, and broke out in three forms at about the same time. **Ichabod Washburn's** tempering process for crinoline wire was probably the first, closely followed by **Webster & Horsfall's** invention of patenting and **George Bedson's** use of continuous annealing back of his newly created continuous galvanizing bath. There has been no significant change in these processes, other than the recent adoption of the practice of heating a running wire by its own resistance to the passage of electricity. This practice, in the form of tempering and of patenting, has so affected properties that it must be regarded as something more than merely a change of fuel. It has been neatly worked out and seems likely not only to have a long and interesting career, in its present field but to break into others.

✦ ✦ ✦

Protective Coatings

PAINT and boiled linseed oil were the earliest protective coats, and seem to have been quite adequate up to the introduction of telegraph wire. The wire was wrought iron, and not likely to rust badly under any conditions. Galvanizing began about the time

(*Please turn to Page 58*)



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Steel is vital to National Defense . . . steel and more steel! *Rodine saved* steel enough last year to have made 3,000,000 one-hundred-pound bombs . . . steel otherwise lost by acid attack in pickling baths. This amazing record of steel *conservation* was made possible by the unique qualities of *Rodine* —saving acid, labor, time; reducing brittleness, blistering, corrosion; eliminating formation and escape of fumes. American Chemical Paint Company specializes in chemicals to save steel . . . has adequate stocks on hand to meet your needs. ACP's 20 years' experience is helping to solve the production problems of America. *Rodine*—and other ACP products —may be your solution. Write for Bulletin No. 13.

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CHEMICALS ACP PROCESSES

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CANADIAN BRANCH
WALKERVILLE . . . ONT.

The Shape of Things To Come

(*Continued from Page 57*)

telegraph wire started running into tonnage, and was done at first by dipping the 12 to 14 lb. wire bundles and shaking off the surplus zinc. Continuous galvanizing came in quite definitely about 1860, and **George Bedson** of Manchester was granted a patent on the process.

✦ ✦ ✦

MR. BEDSON'S letters to **Mr. Washburn** give a fair picture of the process, which from the very beginning included continuous annealing. The latter gave a higher tensile and tougher wire, and after one taste of it the telegraph companies insisted on it. The spelter bath was covered with sand, which constituted the only wipe, and as the wires were for a time spliced at the reels, there must have been some rare old lumps of zinc and sand. It is not surprising that the telegraph people kept crying for longer pieces of wire. Very soon after starting operations Mr. Bedson trained men to weld at the reels, these of course being old fashioned blacksmith's welds. A good welder would draw down about $9.00 a week.

✦ ✦ ✦

LIKE so many other wire operations, galvanizing shook down rapidly, in the magic decade 1855-65, into its final form. There has been no fundamental change in our time. There was a time after the introduction of screw wipers when fence wire was wiped so hard there was scarcely anything left but the color. The consuming farmer was a long way off, barb fence was just barb fence, and nobody was proud of it. Those days have passed. Quality is a live issue now, and producers give their galvanized products brand names, which they advertise nationally. A dozen modifications of the process are being vigorously pushed forward, and we hear of **Crapo, Flamesealed, Galvannealed, Herman** process and the like. The last named is perhaps typical. From the **Herman** kettle, the wire, after an immersion too brief to heat the wire through, rises vertically through a swiftly moving fountain of zinc into a gas-filled chamber, where, after part of the fluid zinc has been drained back, the rest is chilled on the wire by a jet of water before it reaches the air. The product has an envelope of pure zinc keyed to the steel through an alloy bond so thin

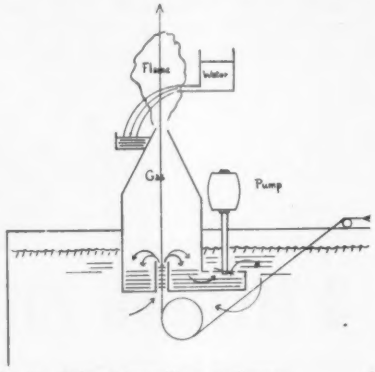


Fig. 11. Galvanizing—Herman Process. ✦

THE WIRE ASSOCIATION MEDAL AWARD FOR 1941

Plaque Presented To

CARLETON W. GARRETT

Wire Mill Metallurgist

Jones & Laughlin Steel Corp., Aliquippa, Pa.

For

The Most Meritorious Paper

On Wire Manufacture or Fabrication

During the Year

By A Member of the Wire Association

C. W. GARRETT

Graduated Michigan College of Mining and Technology, B.S. Ferrous Metallurgy, 1932; Master's Degree, 1933; Instructor, 1934-35. Then successively Ford Motor Co. Metallurgical Laboratory, Cuyahoga Works of American Steel & Wire Co., and Jones & Laughlin Steel Corp., as Welding Wire Investigator. In 1938 became Wire Mill Metallurgist of Aliquippa Works. Member of American Society for Metals, American Institute of Mining and Metallurgical Engineers and The Wire Association.

and flexible that it may be drawn in dies like electro-galvanized wire.

✦ ✦ ✦

THE highest compliment that can be paid electrogalvanized wire is that it is setting the pace, and that all the named hot processes were developed to meet its threat. It is by no means new, my first day in the wire business, thirty-five years ago, was spent electrogalvanizing wire, but it is only within the past ten years that it has been good enough and cheap enough to compete in the general field.

✦ ✦ ✦

IF I were to make a prediction in this field of protective coatings, I should say, "Keep your eye on aluminum." It is an abundant native product, fast getting cheaper, and after this emergency it will be crying for markets. Twelve cent aluminum, which is just around the corner, is, because of its bulk, equivalent to 4 cent zinc. We use zinc chiefly because it is a "sacrificial" metal, that is, by virtue of its position in the electro chemical scale, it will protect the base metal even after the latter is laid bare. Only cadmium, among available elements, excels it in this power. But aluminum is still higher in the scale, and has the further advantage of being unaffected by the acids formed in food products. It would be an ideal coat for steel.

✦ ✦ ✦

THE only hitch is that aluminum will not coat steel. Hot processes have been balked by the frightful avidity of aluminum for oxygen. Minute bits of iron oxide always present on steel wire are reduced to metal by the aluminum, which then spreads out as an oxide film preventing a bond between the metals. A process has been worked out, and is now in the pilot plant stage, to overcome this effect. The steel, raised to a high temperature, is impregnated with hydrogen, which, oozing out as the steel enters the bath, snatches the oxygen away from the aluminum.

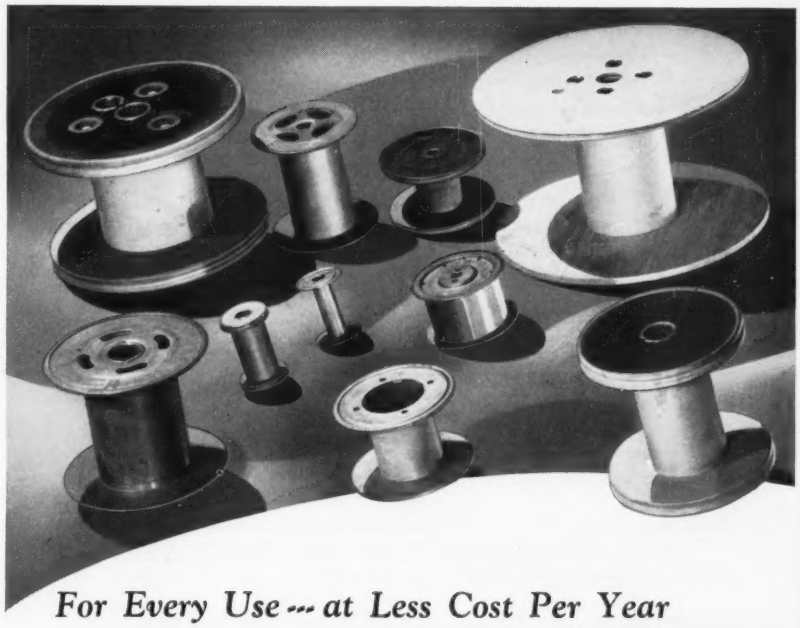
✦ ✦ ✦

FOR many reasons, a cold process would be more suitable, but it has never been possible to plate a decent aluminum coat onto steel in any form. A new process now coming through the pilot plant into the commercial stage, seems reasonably sure to solve this problem. It is an alloy plating process. Plating alloys onto steel has heretofore been successful with only a limited range of copper-bearing alloys. The novelty of this new process is that it throws the metal, not from alloy anodes, but from anodes of pure metals, separately energized, so that by current control the composition of the alloy thrown onto the steel can be closely regulated. Alloys of aluminum with varying amounts of chromium, nickel, tin, copper, and zinc, deposit in a highly satisfactory film.

✦ ✦ ✦

AN interesting feature of this process is that while a thin film of a single metal is apt to be porous, the addition of a second metal greatly increases its density, while third and fourth metals seem to improve it in almost geometric ratio, so that, for in-

(*Please turn to Page 60*)



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HUBBARD SPOOL COMPANY

1622 W. Carroll Avenue, Chicago, Illinois

The Shape of Things to Come

(*Continued from Page 59*)

stance, a three-metal alloy film, even though one metal greatly preponderates, can be extremely thin and yet non-porous. Many dozens of alloys have been explored, and interesting combinations of properties established. The fact that the stainless alloys and monel can be plated on, opens up wide fields for speculation.

✦ ✦ ✦

THIS process is being developed for the flat products, particularly to replace tin plate, but its possibilities in wire are not being overlooked. The high aluminum alloys stand up admirably under accelerated corrosion tests, and some of the nickel compositions come out of the plating tank with a genuine mirror finish. If this development checks out for wire as successfully as it seems to for sheets, it may start a little revolution in protective coatings.

Summary

IN the decade 1855-1865 there came into the wire industry a notable series of advances affecting every detail from the raw material down. The telegraph seems to have touched off the revolution by demanding bigger bundles. In rapid succession there came the continuous rod mill, acid cleaning, lime coating and baking, the breaking down of rods on rotating blocks, continuous heat treatments, and continuous galvanizing. Closely following telegraph wire came three new tonnage products, the wire nail, the barbed fence, and the bale tie, called forth at least in part by the availability of cheaper and better wire. Both bessemer and open hearth steel replaced wrought iron.

✦ ✦ ✦

IN this decade all wire making operations settled down into virtually their present course. Some of them seem destined to keep that course, or to change only by unimportant refinements, but with respect to others it is possible to forecast new courses. In the rolling of wire rods, which now seems to have lagged behind in respect to quality, it is believed that progress will be made by detouring around certain obstacles against which we have been butting our heads. The preparatory operations on rods for drawing seem likely to jog along on or near their present course. Wire drawing will develop along the lines already laid down in pre-stressing experiments. In heat treatment we shall doubtless achieve more success in protecting our surface carbon, while in protective coatings a swing may be expected toward aluminum.

Due to war conditions

WIRE & WIRE PRODUCTS

has suspended delivery of the magazine to the following countries:

AUSTRIA, CZECHOSLOVAKIA, FRANCE, GERMANY, HOLLAND, ITALY, JAPAN, JUGOSLAVIA, NORWAY, POLAND, PORTUGAL, ROUMANIA and SWEDEN.

All subscriptions unfulfilled at the time of discontinuance will be completed after we have won the war.

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ESTABLISHED 1845

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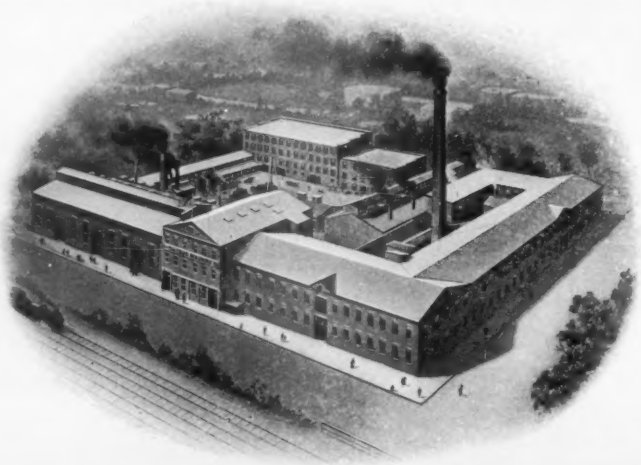

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LITERATURE AVAILABLE ON ALL LISTED UNITS

Continuous Process for Rubber Insulating Wire

(*Continued from Page 31*)

machines is approximately 200 feet long, the actual operating floor space is about 50′ x 20′ for the inspection, cooling, dusting, and winding on reels. The engineers of the **National Electric Products Company** have taken full advantage of the possible space economy with this drive. Figure 6 shows the roof structure consisting of a series of bays. By enlarging one of the bays and putting in concrete flooring, room was created for the location of the three tubers with their attendant steam pipes and motor and control equipment. This room is situated directly above the store room, thus permitting the wire to be pulled off reels in the storeroom and carried through the insulating process. In the foreground the plant engineer **(Mr. G. R. Hofmann)** of the **National Electric Products Company,** may be seen pointing to the three steam vulcanizing pipes as they exit from the tuber room. In the background the author may be seen indicating the entrance of these chambers to the room housing the take-up mechanism. This room, like the other, was made available by raising the bay and putting in concrete flooring at the roof level. This room opens into another section of the factory where the cotton braiding is put over the rubber covered wire, thus as the reels are completed they may be quickly pushed across to the braiding machines.

✦ ✦ ✦

THE vulcanizing chambers in passing the length of the factory are hung overhead and are completely out of the way where they do not interfere with any other equipment, and might simply be considered as overhead steam pipes. Thus, by taking full advantage of this new insulating process and by careful plant layout, the engineers of the National Electric Products Company have turned previously dead space into a high production section.

Specification Paints Explained

MANY manufacturers have been hampered in figuring on Government contracts involving specification finishes, which are usually identified only by code numbers, because of lacking material costs, thinning and drying data, and other essential information. In answer to this need is the publication of a convenient file folder entitled "Facts on U. S. Government Finishes." This folder contains data sheets on the widely used Army and Navy specification finishes and tells how and where they are applied. With this information it is now possible for a manufacturer not heretofore familiar with Army and Navy finishes, to figure his unit costs accurately and establish the most efficient production schedule in keeping with his equipment.

✦ ✦ ✦

THE file folder and an up-to-date set of "Facts on U. S. Government Finishes" may be obtained by writing to Roxalin Flexible Lacquer Company, Elizabeth, N. J. Box 511.

All-Metal WIRE SPOOLS

CABLE SPOOLS . . . *for Insulated and Rubber Covered Wire, Solder, and similar products.*

These spool ends are formed from cold rolled steel of gauges to meet specific demands for strength. The edges are curled and ribs embossed for increased rigidity. Panels may be worked into your design and embossed, for use in marking size and variety. All parts are lithographed for identification purposes and to protect the metal.

Ends and traverses may be shipped unassembled. A simple operation on a hand, foot, or power press makes rigid and permanent assembly.

Made in 5", 6½" and 10½" diameter Ends; Traverses 1 15/16" diameter (or special 3½" diameter for 10½" End), in any desired lengths.

FINE WIRE SPOOLS . . . *for winding and shipping Fine, Steel, Copper, and Enameled Wires.*

Spools are formed from tin plate tested for maximum rigidity. Made with locked-seam barrel and one-piece ends, they are so assembled that there is no possibility of wire being trapped in the joint where barrel and end meet. Ends are made with full curl on edge, which provides additional strength and a smooth winding edge.

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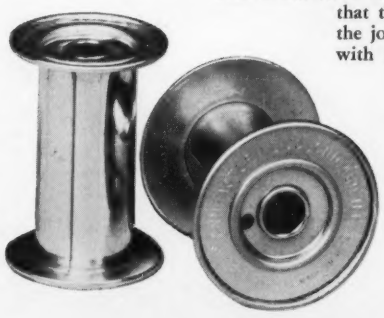
Made in 2 7/16" and 3" diameter Ends. The 2 7/16" size is made with 1½" diameter Traverse only; the 3" diameter with 1½" or 1¾" diameter Traverse.

We will send samples at your request.



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A Review of Recent Wire Patents

No. 2,261,200, METHOD OF WINDING FIELD COILS, patented November 4, 1941 by Fletcher C. Wilson, Macon, Ga.

This method consists in winding a wire to provide coils, in successive groups of coils on a tapered body in the direction toward the larger end of such body, and in stripping the winding by moving the innermost group of coils in the direction away from the larger end over a group of coils of less diameter, and continuing the movement in the same direction with all groups of coils in nested relation.

✦ ✦ ✦

No. 2,261,878, METHOD OF MANUFACTURING COIL SPRINGS, patented November 4, 1941 by Hubert B. Hathaway, Windsor, Ontario, Canada, assignor to L. A. Young Spring & Wire Corporation, Detroit, Mich., a corporation of Michigan.

In a method of making springs from steel wire having carbon content of less than 1%, the steps comprise bending the wire to spring shape and cutting off the bent piece, immediately thereupon flexing the bent piece and subjecting it to heating for a period of less than three seconds at a temperature of 450°F. to 525°F., and cooling the piece in the air.

✦ ✦ ✦

Reissue No. 21,939, TUBULAR WIRE STRANDING MACHINE, patented November 11, 1941 by William Burrows, Warrington, England, assignor to Hanson & Edwards Limited, Warrington, England, a company of Great Britain.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

Original No. 2,218,278, dated October 15, 1940, Serial No. 319,345, February 16, 1940. Application for reissue July 3, 1941, Serial No. 400,996. In Great Britain January 7, 1939.

Included in the machine construction is a roller bearing assembly comprising a revolving tube of uniform diameter throughout its length formed of separate end connected sections, a ring member having portions surrounding adjacent ends of the sections and secured thereto, and a roller bearing surrounding the ring.

✦ ✦ ✦

No. 2,262,247, WIRE DRAWING MECHANISM, patented November 11, 1941 by Norman H. Nye, Cuyahoga Falls, Ohio, assignor to The Vaughn Machinery Co., Cuyahoga Falls, Ohio, a corporation of Ohio.

A hollow rotatable block is provided, with an inner nonrotatable chamber entirely within the block, a cooling liquid between the chamber and the inner surface of the wire-contacting portion of the block, and means for circulating a refrigerant through the chamber.

✦ ✦ ✦

No. 2,262,499, FENCE NAIL, patented November 11, 1941 by Alexander Patton Hunerwadel, Red Bank, Tenn., assignor of one-half to Robert Alexander Hunerwadel, Chattanooga, Tenn.

The shank is twisted and the head is C-shaped so as to partially enclose a wire.

✦ ✦ ✦

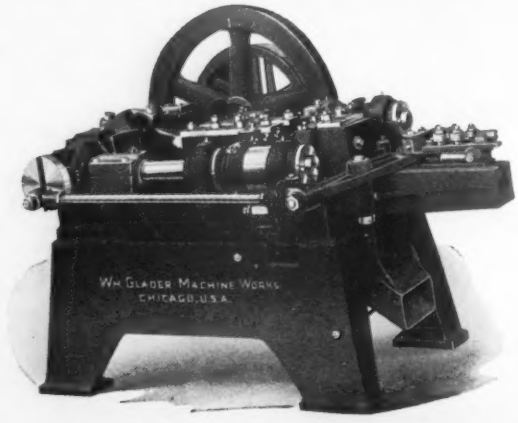
No. 2,262,861, COMPOSITE ARTICLE, patented November 18, 1941 by Edward W. Rugeley, Theophilus A. Feild, Jr., and John F. Conlon, Charleston, W. Va., assignors to Carbide and Carbon Chemicals Corporation, a corporation of New York.

Invention lies in the provision of a covering for wire, consisting of filaments of a vinyl resin substantially identical with a resin resulting from the conjoint polymerization of a vinyl halide with vinyl ester of an aliphatic acid, the resin having an average macro - molecular weight of at least 7500.

✦ ✦ ✦

No. 2,263,246, WIRE-DRAWING MACHINE, patented November 18, 1941 by Weld Morgan, Worcester, Mass., assignor to Morgan Construction Company, Worcester, Mass., a corporation of Massachusetts.

GLADER WIRE NAIL MACHINE SCORES AGAIN



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A new Wire Mill under construction in the State of Texas will install GLADER WIRE NAIL machines 100%.

The production figures on common nails shown below, are guaranteed.

SIZE MACH.	SIZE WIRE	MAX. LENGTH OF WIRE	NUMBER OF NAILS PER MIN.	CAP. IN POUNDS PER HR.
#00A	#16	1⅛"	700	37.2
#00	#14	1¼"	550	55
#0	#12	1¾"	450	89
#1	#10	2½"	400	192
#2	#8	3½"	325	310
#3	#4	5"	225	523
#4	#1	7"	190	622
#4s	5/16"	9"	175	1155
#5	⅜"	12"	160	2400

This high output and economical operation account for the GLADER machine being accepted as standard equipment in all recent installations.

In order to regulate back tension this inventor provides, in a plural die and drum assembly, means to drive one of the drums at a predetermined speed, an adjustable displacement hydraulic motor connected to another of the drums to drive the same, and means to supply fluid to the motor at a predetermined pressure.

✦ ✦ ✦

No. 2,263,287, WIRE COVERING MACHINE, patented November 18, 1941 by Magloire Brodeur, Providence, R. I., assignor of one-half to Eleuterio Mollicone, Johnston, R. I.

This machine is adapted to apply a filamentary covering to wire.

✦ ✦ ✦

No. 2,263,572, ELECTRICAL RESISTANCE ELEMENT, patented November 25, 1941 by Reginald S. Dean, Washington, D. C., assignor to Chicago Development Company, Chicago, Ill., a corporation of Illinois.

The invention contemplates an electrical resistance alloy, capable of being drawn into wire or sheet form, comprising an alloy containing at least 75% but not more than about 98% manganese, and substantially all of the balance being at least one of the elements selected from the group consisting of nickel and copper.

✦ ✦ ✦

No. 2,263,601, METHOD FOR ENCASING OR COATING WIRES, RODS, OR TUBES WITH GLASS OR OTHER THERMOPLASTIC SUBSTANCES, patented November 25, 1941 by Alfred Wendler, Berlin-Dahlem, Germany.

This method comprises placing the wire to be encased, heating to plastic heat any point of the glass tube, pulling the wire through the heated point, drawing at the same time and with the same speed as the wire the heated point of the glass tube to a thin wall encasing the wire, and preventing heating of the wire at the heating and drawing out point to a temperature at which the glass would adhere and melt on to the wire.

✦ ✦ ✦

No. 2,264,213, FLEXIBLE TUBING, patented November 25, 1941 by Walter Larkin, Norristown, Pa., assignor to Fidelity Machine Company, Wilmington, Del., a corporation of Delaware.

A seamless circular-knit tube is provided, composed of successively interknit stitch courses, and a resilient wire formed into active convolutions respectively incorporated in predetermined courses and constantly tending to twist the tube circumferentially about its axis.

✦ ✦ ✦

Variable-Voltage Improves Wire Drawing

WIRE is drawn by pulling it through a succession of dies. Between each die is a motor-driven drum, around which the wire is snubbed. Obviously the motors must always maintain the same ratios of speed, from threading at low speed to running at high speed. The motors heretofore have been supplied from a constant-voltage bus, the speeds being controlled by field rheostats positioned mechanically by the wire itself.

THE George W. Prentiss Company of Holyoke, Mass., has developed a wire-drawing bench using variable-voltage motors supplied by Westinghouse. Rheostats and mechanical connections are eliminated. Once the proper field adjustments are made to each motor, they can be simultaneously started from standstill, operate at low speeds for threading, and on up to full running speeds—simply by raising the supply voltage. The motors through all this maintain their speed ratios so exactly that tension in the wire is constant on each side of each die. The result is greater mechanical and operating simplicity. Breaks occur less frequently in the wire; starts are smoother.

For Information
Regarding
The Wire Association
Address
Richard E. Brown, Secretary
Stamford Trust Co. Bldg.
300 Main Street, Stamford, Conn.

YOU are a user of wire — but are you using the *proper* wire for each specific need? Federal experts assert easy peacetime practice plays too safe — specifying far stronger wires than are actually required. Many defense-needed alloys are being wasted when less critical metals could serve. Now, also, many plants are finding it difficult to speed up production because they are using wires of unsuitable physical properties. There is a proper wire for every purpose.

Re-examine *your* wire position in the interests of efficiency, economy — and patriotism! Callite's staff of expert technicians will gladly aid you — particularly if your problems concern fine wires and special alloys. For here is a field which Callite has almost completely made its own through precision production of high quality fine wires, *dependably uniform* in temper, tolerance and finish — in sizes down to .001" (smaller in certain cases). . . . .

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Outline of Canadian Price and Wage Control

IN an important and far-reaching move to check inflation, the Canadian Government has promulgated new wartime controls over prices and wages. Basically the controls are "freezing" orders intended to maintain the status quo.

+ + +

THE price control, which is to begin December 1, establishes a general price ceiling for all commodities and certain services at the maximum price for which the same or similar quality goods or services was sold during the period September 15—October 11. The wage control, which is effective with the pay-roll period beginning on and after November 15, stabilizes basic wage rates at the level of that day, but with the proviso that workers are to receive additional compensation in the form of a bonus for any further increase in the cost of living. Both the price and wage controls will apparently go into effect as general orders, departures from which will be authorized as administrative experience establishes the need. At present it is impossible to do more than take account of the skeleton of the controls, and these are presented herewith, in condensed form, according to the Department's information at the time of going to press.

+ + +

Maximum Prices Regulations

THE Maximum Prices Regulations make it an offense for anyone to sell or supply, or offer to sell or supply goods and certain services at a price that is higher than the maximum price at which the person sold or supplied goods or services of the same kind or quality during the period September 15—October 11, both days included.

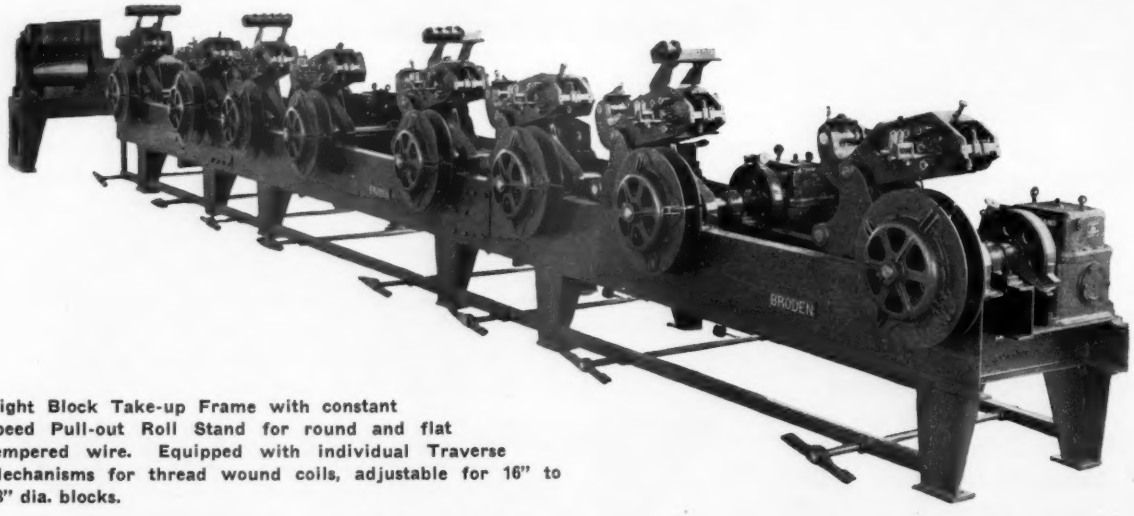
+ + +

PURCHASERS as well as sellers are bound. The terms and conditions of sale may not be altered for the purpose of increasing prices over the maximum of the base period. Forward contracts which do not comply with the regulations must be revised. If a person sells or supplies goods or services of a kind or quality not sold or supplied during the base period, he must, if necessary, prove that the transaction does not contravene the regulations. Charges for goods or services which are in excess of the maximum are not enforceable, and any amount paid above the maximum may be recovered. Goods bought or sold in violation of the regulations are liable to seizure.

+ + +

Sales to Department of Munitions And Supply Excluded, as Also Exports

IT is to be noted particularly that the regulations do not apply to sales to the Canadian Department of Munitions and Supply, the government's war purchasing bureau, or any of its agencies. There is a specific exemption also for goods to be exported from



Eight Block Take-up Frame with constant speed Pull-out Roll Stand for round and flat tempered wire. Equipped with individual Traverse Mechanisms for thread wound coils, adjustable for 16" to 48" dia. blocks.

WIRE DRAWING MACHINES — SINGLE AND DOUBLE DECK — CONTINUOUS MULTI DRAFT. PATENTING — GALVANIZING — TINNING FRAMES. FINE WIRE SPOOLERS. WIRE FLATTENING MILLS — FILING AND EDGING MACHINES. SHEARS — SCALE BREAKERS — SCRAP BALLERS — NAIL GALVANIZING AND BLUEING EQUIPMENT.

THE BRODEN CONSTRUCTION COMPANY

Subsidiary of The Wean Engineering Co.
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Canada by the person selling them or his agent. Goods normally sold by auction are excepted, as also the personal or household effects of a person selling them.

✦ ✦ ✦

BILLS of exchange, securities, title deeds, or similar instruments are outside the scope of the control. Goods on which prices have heretofore been fixed by the Prices Board, or by any other Federal, Provincial, or other authority with the written concurrence of the Board, are also exempted from the regulations.

✦ ✦ ✦

Certain Services Covered by the Prices Control

IN addition to commodities, the price control will apply to certain services, viz, the supply of electricity, gas, steam, heat, and water; telegraph, telephone, and wireless service; transportation of goods and persons; the provision of dock, harbor, and pier facilities; warehousing and storage; undertaking and embalming; laundering, cleaning, tailoring, and dressmaking; hairdressing and beauty-parlor services; plumbing, heating, painting, decorating, cleaning and renovating; repairing of all kinds; the supplying of meals, refreshments, and beverages; and the exhibition of motion pictures.

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Administration—Problem of Imports and Exports

THE Wartime Prices and Trade Board will administer the Maximum Prices Regulations, and it is given full power to vary prices, prescribe terms and conditions of sale, and to exempt any person, goods, or services wholly or partly from the regulations. This plenary power of the Board is of special interest because of the obvious complications to price control posed by the Dominion's large import and export.

✦ ✦ ✦

TO keep prices down to the ceiling, it may be necessary to buy essential raw materials at the market price in the country of origin, and resell to processors at a lower price, the government assuming the loss. Further control

(*Please turn to Page 66*)

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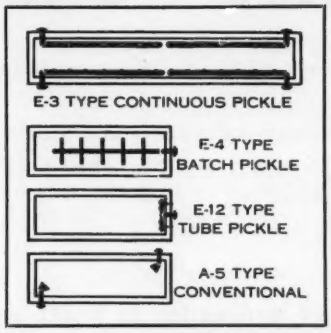

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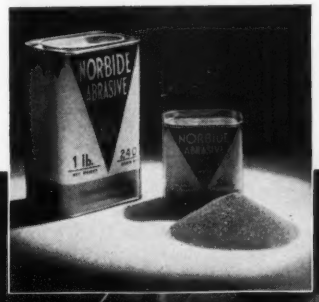

Efficiently and Economically Shaping, Grinding and Polishing Cemented Carbide Wire Drawing Dies. Information on request.

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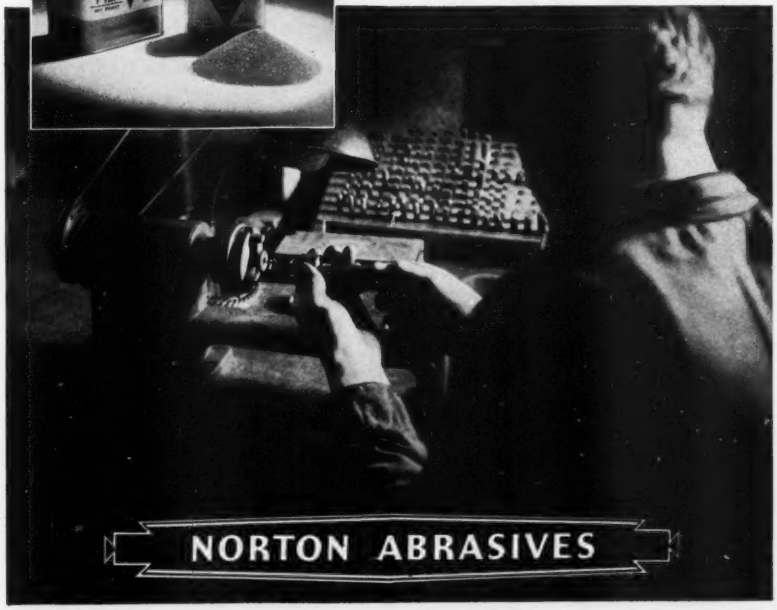

N-44

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Warner Company
Bellefonte Division

Sales Offices: Pittsburgh, Philadelphia, Bellefonte, N. Y. City

Outline of Canadian Price and Wage Control

(*Continued from Page 65*)

over export trade may likewise be necessary.

✦ ✦ ✦

Price and Wage Controls Related

THE price control will have a direct bearing on the wage control, because the latter provides that total compensation will be governed by the fluctuation in the cost-of-living index and it will be one of the objects of the price control to maintain this index, as nearly as possible, at the September 15—October 11 level. The two controls are interlocking: the price control will help to maintain the wage control; the wage control will help to maintain the price control through its influence on production costs.

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THE cost-of-living bonus must be paid to all employees other than those above the rank of foreman or comparable ranks and it will be calculated according to the following formula:

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FOR male employees over 21 years of age and female employees receiving a basic wage (overtime pay not included) of $25 per week, the bonus will be at the rate of 25 cents per week per point change in the index.

✦ ✦ ✦

FOR male employees under 21 years of age and female employees receiving a basic wage of less than $25 per week, the bonus will be at the rate of 1 percent per week of the basic wage (overtime pay excluded) per point change in the index.

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THE first pay roll on which a bonus must be paid generally under the wage control is that for the period beginning on or after February 15, 1942. At that time the change in the cost-of-living index for January 1942 over that for October will be the criterion of the payment. Thereafter the charge in the bonus payment will be redetermined quarterly, effective for the first pay-roll periods beginning on and after February 15, May 15, August 15, and No-

vember 15, on the basis of the change in the cost-of-living index number for January, April, July, and October, respectively, of each year.

✦ ✦ ✦

THE amount of the bonus will not change (i. e., rise or fall), unless the index has changed one point, measured to the nearest tenth of a point, in terms of the August 1939 index number as 100. The amount of the change in the index will be announced officially and will not be left to the determination of the individual employer.

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Wage Plan Already in Effect in Some Industries

AN important point about the application of the wage plan is that it is not new in essence but an extension of a system already in effect in many plants. On the Dominion government's initiative the war idustries and some others coming more or less directly under Ottawa's supervision adopted the cost of living bonus earlier this year as the means of dealing with wartime wage disputes. As these disputes came up for settlement, the conciliation boards appointed to arbitrate them were advised to consider the basic wage rate paid by the employer in 1926-29 (or any higher level established prior to December 16, 1940), "generally fair and reasonable," and to recommend in addition the payment of a wartime cost of living bonus based on the rise in the cost of living index since August 1939.

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FOR these industries the new control simply continues the plan with a slight change in the basis of calculation of the bonus for the lower paid workers. On the pay roll period beginning November 15 the bonus payment in these industries will be revised to the amount called for by the rise in the cost of living index for October. Thus the workers in this group will enter the generalized control in 1942 on the same condition as the workers not in this group—that an adjustment will be due them in February for the change in the January index number over the index number for October. Their total bonus at that time, however, will be determined not by the adjustment for January over October but for January over the whole war period, i. e., back to August 1939, or to such other date as their base pay was generally revised.

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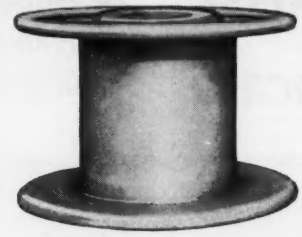
IT is apparently not the intention of the new control to prevent equalization of the bonus in the "nonwar" industries to the level paid in the "war" group where the basic wage situation permits. The fact that there has been no control on basic wage rates in these industries, however, seems to leave the question of the total bonus payment open. The wording of the control order says that the bonus to be paid by the employer on the pay roll beginning February 15 will be based on the rise in the index for January 1942 over the index number for October 1941 or "for such earlier month, not earlier than the effective date of the last general increase in wages and not earlier than August 1939, as the National Labor Board finds fair and reasonable."

FOR HIGHEST SPEEDS



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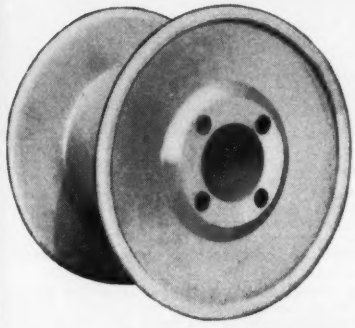

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Existing Labor Agreements Must Conform for the Duration Of the War

IT is provided that any collective labor agreement which is inconsistent with the provisions of the new wage order shall be brought into conformity with the order not later than January 1, 1942. An agreement so modified, however, or any other condition of work otherwise suspended in the interest of war production is to be fully restored on the termination of the war.

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Some Employers Excepted From The Wage Control

CERTAIN employers are excepted from the provisions of the wage control, viz, any person, firm or corporation engaged in agriculture, horticulture, fishing, hunting, or trapping, or employing less than 50 persons, but in the case of those engaged in building or other construction, the exception

(*Please turn to Page 68*)

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PATENTING
TEMPERING
ANNEALING

The Trauwood PROCESS

OUTSTANDING ADVANTAGES

Higher and more uniform physical and fatigue properties.

No surface decarburization or scale.

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The Trauwood Process, new in principle, eliminates high temperature furnaces and lead pots with their excessive maintenance costs and low thermal efficiencies. More positive temperature control is possible and quenching is done in a RISING temperature—instead of falling, as in conventional heat treating methods. The rapid rate of heating (4 to 5 times as fast as furnace heating) increases production and uniformly produces a finer grained product with higher physical and fatigue values.

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THE TRAUWOOD ENGINEERING COMPANY

1740 E. 23rd STREET, CLEVELAND, OHIO, U.S.A.

Outline of Canadian Price and Wage Control

(*Continued from Page 67*)

applies only to those employing less than 10 persons; any hospital, religious, charitable, or educational institution or association operated on a nonprofit basis; and divisions of government, including the Dominion government, the provinces and municipalities and their departments and agencies. Notwithstanding these exceptions, no employer engaged in the manufacture of war supplies or in the construction of defense projects is exempted.

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National War Labor Board Appointed

A NATIONAL War Labor Board is established by the wage order as the administrative agency of the plan. No employer may increase his basic scale of wage rates except on written permission of the Board. If the Board finds that any employer's basic scale of wage rates is low compared with the rates generally prevailing for the same or substantially similar occupations in the locality, or a locality which in the Board's opinion is comparable, it may prescribe such increased wage rates as it finds fair and reasonable.

✦ ✦ ✦

IF it finds that any employer's basic scale of wage rates is "enhanced" as compared with the rates generally prevailing for the same or substantially similar occupations in a locality which the Board considers comparable, it may order that the cost of living bonus be deferred or adjusted for such periods and by such amounts as it finds fair and reasonable.

✦ ✦ ✦

ANY employer may apply to the Board for exemption from the bonus and if it be clearly shown that he is financially unable to pay it, the Board may order his exemption, in whole or in part, subject to such conditions as it deems advisable. On the other hand, an employer who pays wages or bonus in excess of the authorized amounts may find these amounts disallowed on his income and excess profits tax, in addition to any other penalties he may incur.

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Labor and Employers Represented; Provinces on the Regional Boards

THE Board will consist of a chairman and four or more members representing employers and four or more representing employees. The chairman will be chosen by the Government. The members will be appointed by the Government on the recommendation of the National Labor Supply Council, a wartime advisory body on which labor and employers are represented.

✦ ✦ ✦

ON the direction of the Dominion Minister of Labor the Board may investigate wage conditions generally.

✦ ✦ ✦

The Basic Factors Retarding American War Production

THE annual rate of American armament production effort still falls six to twelve billion manhours short of the effort needed to close the gap between Axis and

British war production, according to a study just released by **Farrel-Birmingham Company, Inc.**, Ansonia, Connecticut. The yearly rate of defense production at the end of July, according to the authors, approximates five billion man-hours of factory effort, as compared to an estimated need of eleven to seventeen billion man-hours yearly.

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THIS new study, in booklet form, points out three major factors retarding American war production. The authors find, from official Federal reports, that strikes directly resulted in a loss of 147 million man-hours of effort in the year ending July, 1941. A second cause, the limitation of the work-week to 40 hours, is suggested from the figures showing an average work-week of only 44.9 hours in durable goods industries and 38.6 hours in consumable goods industries for July, 1941. The third factor retarding output is found in the artificial rise in wage rates, resulting in higher costs for defense output and consequent acceleration of the tendency toward inflation.

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THE booklet, entitled, **"The Basic Factors Retarding American War Production,"** includes a series of tables comparing the annual employment, man-hours of effort, weekly working hours and time lost from strikes for two twelve-months periods, that ending July, 1940 and that ending July, 1941.

✦ ✦ ✦

THE booklet also includes a table showing that the estimated factory effort of the Axis Powers combined probably totals 24 to 32 billion man-hours yearly, as compared to an estimated total of 13 to 15 billion man-hours for the British Empire. The deficiency of the British Empire, namely 11 to 17 billion man-hours yearly, is the gap to be closed by American production. The present rate of armament production in the United States is estimated at only one-half the minimum and one-third the probable optimum required.

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Treasury Booklet Tells How to do Business With Government

A BOOKLET designed to supply information to manufacturers and dealers on procedures necessary to establish and maintain business relations with the Procurement Division of the Treasury Department was issued recently.

✦ ✦ ✦

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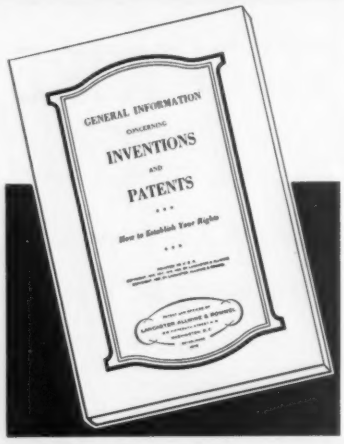

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TO keep up to date its triennially published Book of Standards, the American Society for Testing Materials in the two intervening years issues Supplements to each Part of the Book. The 1941 Supplement, which will be the last one issued (in 1942 a complete new Book of Standards will be prepared) has been published as of December, 1941, and gives in their latest approved form the 370 specifications, tests and definitions, either issued for the first time in 1941 or revised.

✦ ✦ ✦

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✦ ✦ ✦

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✦ ✦ ✦

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COPIES of the Supplement, each of which includes correction stickers for affixing in the previous books, can be obtained from the A.S.T.M. Headquarters, 260 S. Broad St., Philadelphia, at $3 for any one part, $5 for any two parts, and $7 for all three parts. Each Supplement is bound in durable cloth binding with the backstrap designed to match the Book of Standards. Half-leather bindings are also available upon the additional payment of $1 per part.

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Outstanding Personalities of The Wire Industry

(*Continued from Page 45*)

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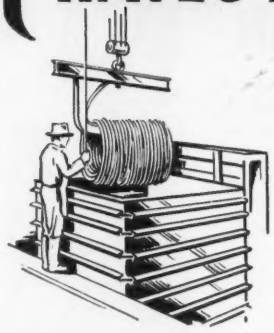

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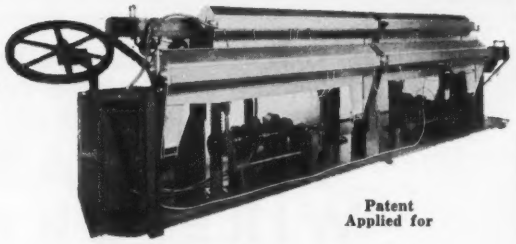

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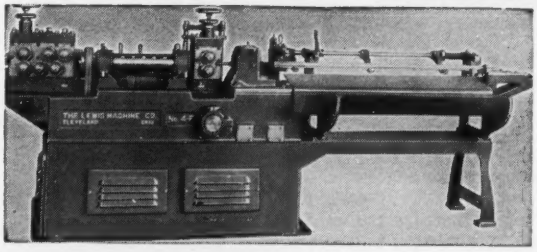

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✦ ✦ ✦

COMPREHENSIVE tables outlining the specifications of most of these materials have been arranged in such a manner as to make this information readily accessible. Suggested formulae for the manufacture of numerous finished products and the index by industries, which has always been a useful guide to chemists, manufacturers, and technical workers, have been brought up to date. Requests for this catalog will be filled by the Glyco Products Company, Inc., Dept. W, 230 King Street, Brooklyn, New York.

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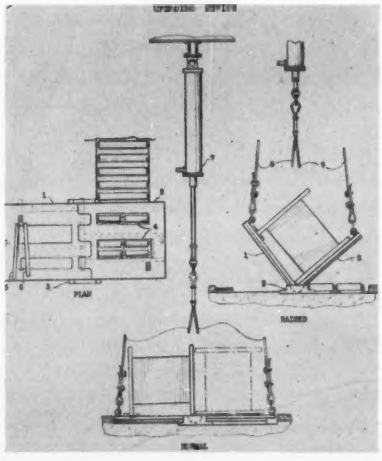
Device for Upending Heavy Objects Developed for Western Electric's Kearny, N. J., Wire Drawing Plant

THE value of the upending devices (see illustration) will be apparent to anyone who has tried to gently upend a heavy object such as a reel of wire, a steel barrel, a crate of machinery or the like. Such objects can usually be raised to the balance point with a crowbar or rope sling combined with an excess of manual labor, but to lower them easily without shock after passing the balance point is next to impossible except by the use of special equipment.

✦ ✦ ✦

THE new device, patent number 2,236,010, was developed for the Kearny, N. J., wire drawing plant of the **Western Electric Company** to upend 1000-pound reels of wire from a rolling position and place them on a conveyor with the reel axis vertical. The two flat castings (1) and (2) are designed identical in shape and dovetail together to form a large hinge with the base member (3) serving as the socket. The conveyor rollers project through the openings (4) in the secondary casting and the two guiding strips (5) and (6) welded to the primary casting assist the operator in rolling the reel into position. As the outer edge of the right flange is guided along the center line of rotation of the hinge, the left flange drops into the larger opening in the primary casting to restrain the



(*Please turn to Page 74*)

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Device for Upending Heavy Objects Developed for Western Electric's Kearny, N. J., Wire Drawing Plant

(*Continued from Page 73*)

reel from rolling further. The air hoist (7) lifts castings (1) and (2) as shown in the "Raised" view and with cable (8) adjusted shorter than cable (9) the primary casting is supported slightly higher than the secondary thus transferring the load to the secondary casting. As air is exhausted from the hoist the reel is lowered gently onto the conveyor rollers.

✦ ✦ ✦

SINCE the load rating of these rollers is little more than twice the dead weight of the reel their life is entirely dependent on the peak stresses encountered as the reel is lowered into its final position. Control of the air flow from the hoist cushions this motion so well that nine units have been in operation for two years without a single roller failure.

✦ ✦ ✦

FROM the installation standpoint this design has the advantage of projecting a maximum depth below the floor line of only three inches for the socket casting and two inches for castings (1) and (2). This is a most important factor for locations where the concrete reenforcing rods lie close to the surface.

✦ ✦ ✦

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✦ ✦ ✦

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✦ ✦ ✦

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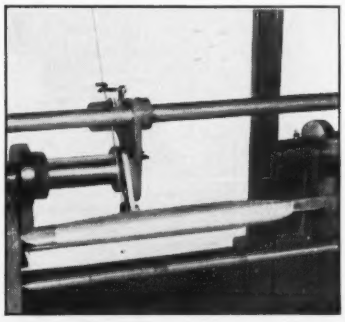

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✦ ✦ ✦

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Index to Advertisers

A

Ajax Manufacturing Co., The 3
American Brass Co., The 35
American Chemical Paint Co. 57
American Insulating Machinery Co. 71
American Lanolin Corp. 72
Apco Mossberg Co. 67

B

Balloffet Dies & Nozzle Co., Inc. 73
Bethlehem Steel Co. 2
Broden Construction Co., The 64

C

Callite Tungsten Corp. 63
Carboloy Company, Inc. 1
Carl-Mayer Corp., The 5
Clark, J. L. Mfg. Co. 61
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co. 11
Cochaud Wire Die Corp. 73
Continental Steel Corp. 69
Crepe-Kraft Co., The 69

D

Davis, R. L., Electric Co. 75
Durant, Mfg. Company 75

E

Electric Furnace Company ..... Back Cover
Emory, Robert J., Company 75
Entwistle, James L. 75

F

Fidelity Machine Co. 75
Firth-Sterling Steel Co. 14-24-25
Fort Wayne Wire Die, Inc. 73

G

Glader, Wm., Machine Works 62

H

Hartley, Geo. D. 74
Haveg Corp. 71
Heil & Company 65
Hubbard Spool Company 59
Hudson Wire Company ..... Inside Back Cover
Hy-Carbo Steel Company 74

I

Indiana Wire Die Co. 73

J

Jones & Laughlin Steel Corp. 8-9

K

Keagler Brick Co. 75
Kelly Wire Die Corp. 73
Keystone Steel & Wire Co. 39
Krause, F., & Co., The 73

L

Lancaster, Allwine & Rommel 70
Lewis, K. B. 74
Lewis Machine Co., The 71

M

Micro Products Co. 47
Miller, R. H., Co. 72
Morgan Construction Co. 48-49
Moslo Machinery, Inc. 71
Mossberg Pressed Steel Corp. 56

N

National Annealing Box Co. 75
National Machinery Exchange 74
New England Butt Co. 75
New Richmond Hotel 74
Nilson, A. H., Machine Co. 7
Norton Company 65
Nukem Products Corp. 50

O

Oakite Products, Inc. 70

P

Platt Bros. & Co., The 75

R

Richards, G. Whitfield 54
Robertson, John Co., Inc. 44
Ross, J. O., Engineering Corp. 75
Royle, John & Sons 75
Ruesch, H. J. Machine Co. 75
Rusch Wire Die Corp. 73

S

Scott, Henry L., Co. 53
Scudder, E. J., Foundry & Machine Co. 75
Sheffield Steel Corp. 68
Shuster, F. B., Co. 74
Sleeper & Hartley, Inc. 28
Smit, J. K. & Sons, Inc. 66
Standard Industrial Compounds Co. 72
Standard Machinery Company 51
Stevens Metal Products Co., The 13
Surface Combustion Corp. 75
Syncro Machine Co. 6

T

Terkelsen Machine Co. 75
Thomson-Judd Wire Machinery Co. 75
Torrington Manufacturing Co., The 40-41
Trauwood Engineering Co., The 68
Tungsten Electric Corp. 55

V

Vascoloy-Ramet Corp. 12
Vaughn Machinery Co. ..... Front Cover
Vianney Wire Die Works 73

W

Warner Company 66
Waterbury-Farrel Fdry. & Machine Co. 10
Watson Machine Co. 60
Wayne Wire Die Co. 72
Willey's Carbide Tool Co. 72
Wilson, Lee, Engineering Co. ..... Inside Front Cover

WHERE TO BUY

For more complete information, consult the annual Wire and Wire Products Directory, Index & Buyers' Guide.

ABRASIVES—
Norton Co., Worcester, Mass.

ACID JETS AND COILS—
Heil & Co., Cleveland, Ohio

AIR DRAW FURNACES—
Carl-Mayer Corp., The, Cleveland, Ohio

ANNEALING MACHINES—Open Flame
Syncro Machine Co., Rahway, N. J.

ANNEALING POTS AND BOXES—
National Annealing Box Co., Washington, Penna.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.

ARMORING EQUIPMENT—
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

AUTOMATIC SPARK TESTING EQUIPMENT—
Entwistle, James L., Pawtucket, R. I.

BAKERS—Hi-Speed
Carl-Mayer Corp., The, Cleveland, Ohio

BAKERS—Rod and Wire
Carl-Mayer Corp., The, Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
Moslo Machinery, Inc., Cleveland, Ohio
Ross, J. O., Engineering Corp., New York, N. Y.

BERYLLIUM COPPER—Strip and Bars
Callite Tungsten Corp., Union City, N. J.

BOBBINS—Braider and Wire Weaving
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BORTZ—Diamond
Smit, J. K., & Sons, Inc., New York, N. Y.

BRICKS—Acid Proof
Keagler Brick Co., Steubenville, Ohio

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANERS—Hand and Metal
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

WHERE TO BUY, Continued

CLEANING & PICKLING EQUIPMENT—
Broden Construction Co., Cleveland, Ohio
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Haveg Corp., Newark, Del.
Morgan Construction Co., Worcester, Mass.
Nukem Products Corporation, Buffalo, N. Y.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio

CLOTH TESTERS—
Scott, Henry L., Co., Providence, R. I.

CLOTH—Wire, All Metals
Callite Tungsten Corp., Union City, N. J.

COATING—Protective
American Lanolin Corp., Lawrence, Mass.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, Ohio
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Manufacturing Co., The, Torrington, Conn.

COILERS AND SPOOLERS FOR INSULATED WIRES—
Entwistle, James L., Pawtucket, R. I.

COILS—Steam
Heil & Co., Cleveland, Ohio

COLD HEADERS—
Ajax Manufacturing Co., Cleveland, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Wire Drawing
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUSTOM WIRE DRAWING—
Hy-Carbo Steel Co., Lowell, Mass.

CUTTING TOOLS—Carbide
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Vascoloy-Ramet Corp., North Chicago, Ill.

DIAMONDS—Industrial
Callite Tungsten Corp., Union City, N. J.

DIAMOND POWDERS—
Rusch Wire Die Corp., New York, N. Y.
Smit, J. K., & Sons, Inc., New York, N. Y.

DIAMOND TOOLS—
Rusch Wire Die Corp., New York, N. Y.

DIES—Diamond
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Cochaud Wire Die Corp., New York, N. Y.
Fort Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Krause, F., & Co., Inc., Jersey City, N. J.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Jersey City, N. J.

DIES—Lead Extrusion
Robertson, John, Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Fort Wayne Wire Die, Inc., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Krause, F., & Co., Inc., Jersey City, N. J.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Jersey City, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Rod & Tube Drawing
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Tungsten Electric Corp., Union City, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tantalum Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tungsten Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Tungsten Electric Corp., Union City, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIRECT ELECTRIC RESISTANCE HEAT TREATING—
Trauwood Engineering Co., Cleveland, Ohio

DRAW BENCHES—
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Standard Machinery Co., Providence, R. I.
Vaughn Machinery Co., Cuyahoga Falls, O.

DRUMS—Flange Steel
Stevens Metal Products Co., Niles, Ohio

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

ENGINEERS—Consulting Wire Mill
Hartley, George D., Worcester, Mass.
Lewis, Kenneth B., Worcester, Mass.

EQUIPMENT—Insulation Testing
Davis, R. L., Electric Co., Wallingford, Conn.
Entwistle, James L., Pawtucket, R. I.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FLASH BAKER—
Carl-Mayer Corp., The, Cleveland, Ohio

FLUXES—Soldering
American Chemical Paint Co., Ambler, Pa.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

FURNACES—Annealing
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Surface Combustion Corp., Toledo, Ohio
Trauwood Engineering Co., Cleveland, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Automatic
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Surface Combustion Corp., Toledo, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Brazing
Electric Furnace Co., Salem, Ohio
Firth-Sterling Steel Co., McKeesport, Pa.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, Ohio
Surface Combustion Corp., Toledo, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Electric
Electric Furnace Co., Salem, Ohio
Surface Combustion Corp., Toledo, Ohio
Trauwood Engineering Co., Cleveland, Ohio

FURNACES—Hardening & Tempering
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Surface Combustion Corp., Toledo, Ohio
Trauwood Engineering Co., Cleveland, Ohio

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio
Robertson, John, Co., Brooklyn, N. Y.
Surface Combustion Corp., Toledo, Ohio

FURNACES—Non-Oxidizing
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Surface Combustion Corp., Toledo, Ohio

FURNACES—Normalizing
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Surface Combustion Corp., Toledo, Ohio

FURNACES—Salt Bath
Electric Furnace Co., Salem, Ohio
Surface Combustion Corp., Toledo, Ohio

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Surface Combustion Corp., Toledo, Ohio
Wilson, Lee, Engr. Co., Cleveland, Ohio

GALVANIZING EQUIPMENT—
Wilson, Lee, Engr. Co., Cleveland, Ohio

GALVANIZING KETTLES—
National Annealing Box Co., Washington, Penna.

GRINDERS—Roll
Norton Co., Worcester, Mass.

HI-SPEED BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

INHIBITORS—
American Chemical Paint Co., Ambler, Pa.

INSTRUMENTS—Electrical
Entwistle, James L., Pawtucket, R. I.

JETS—Steam
Heil & Co., Cleveland, Ohio

KETTLES—Galvanizing, Annealing, Tinning, etc.
National Annealing Box Co., Washington, Penna.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LIME—
Warner Company, The, Bellefonte, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Standard Industrial Compounds Co., Chicago, Ill.

LUBRICANTS—Wire Drawing
Oakite Products, Inc., New York, N. Y.
Richards, G. Whitfield, Philadelphia, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Robertson, John, Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.

MACHINERY—Bunching
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Mach'y. Co., Phila., Pa.
Entwistle, James L., Pawtucket, R. I.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

MACHINERY—Chain Making
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Coilers
Broden Construction Co., Cleveland, Ohio
Entwistle, James L., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
New England Butt Co., Providence, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cold Heading with Wire Drawing Attachment
Ajax Manufacturing Co., The, Cleveland, O.

MACHINERY—Copper Wire Drawing and Rolling
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire
Fidelity Machine Co., Philadelphia, Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Cutting
Ajax Manufacturing Co., Cleveland, O.
Broden Construction Co., Cleveland, Ohio
Lewis Machine Co., The, Cleveland, Ohio
Moslo Machinery, Inc., Cleveland, Ohio
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Shuster, F. B., Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Manufacturing Co., The, Torrington, Conn.

MACHINERY—Die Making
Firth-Sterling Steel Co., McKeesport, Pa.

MACHINERY—Draw Benches
Ajax Manufacturing Co., Cleveland, O.
Standard Machinery Co., Providence, R. I.
Torrington Manufacturing Co., The, Torrington, Conn.

MACHINERY—Edging
Standard Machinery Co., Providence, R. I.
Torrington Manufacturing Co., The, Torrington, Conn.

MACHINERY—Enameling
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Extruding
Robertson, John, Co., Brooklyn, N. Y.
Royle, John, & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, Ohio
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Manufacturing Co., The, Torrington, Conn.

MACHINERY—Forming
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Torrington Manufacturing Co., The, Torrington, Conn.

MACHINERY—Galvanizing
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, Ohio
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Gang Winders
Fidelity Machine Co., Philadelphia, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Lead Encasing Presses, etc.
Robertson, John, Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
Robertson, John, Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Manufacturing Co., The, Torrington, Conn.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Manufacturing Co., The, Torrington, Conn.

MACHINERY—Material Handling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

MACHINERY—Measuring Wire & Cable
Davis, R. L., Electric Co., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wis.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Paper Covering Wire
Terkelsen Machine Co., Boston, Mass.

MACHINERY—Pointing
Broden Construction Co., Cleveland, Ohio
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Quill Winding
Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, Ohio
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Torrington Manufacturing Co., The, Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Rubber for Insulating Wire
Royle, John, & Sons, Paterson, N. J.

MACHINERY—Rubber Strip Covering
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Manufacturing Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, Ohio
Emory, Robert J., Co., Newark, N. J.
New England Butt Co., Providence, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I. (Special Designs)
Syncro Machine Co., Rahway, N. J.
Torrington Manufacturing Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Mach'y Co., Phila., Pa.
Emory, Robert J., Co., Newark, N. J.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Manufacturing Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Manufacturing Co., The, Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Ajax Manufacturing Co., The, Cleveland, O.
Broden Construction Co., Cleveland, Ohio
Lewis Machine Co., The, Cleveland, Ohio
Moslo Machinery, Inc., Cleveland, Ohio
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Shuster, F. B., Co., New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Manufacturing Co., The, Torrington, Conn.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Construction Co., Cleveland, Ohio
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Manufacturing Co., The, Torrington, Conn.

MACHINERY—Swaging
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing
Entwistle, James L., Pawtucket, R. I.
Scott, Henry L., Co., Providence, R. I.

MACHINERY—Testing Size of Wire
Davis, R. L., Electric Co., Wallingford, Conn.

MACHINERY—Testing Spring
Standard Machinery Co., Providence, R. I.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.
Torrington Manufacturing Co., The, Torrington, Conn.

MACHINERY—Trolley Wire
Torrington Manufacturing Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

WHERE TO BUY, Continued

MACHINERY—Tube Mill
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Manufacturing Co., The, Torrington, Conn.

MACHINERY—Welding Wire
Micro Products Co., Chicago, Ill.
Shuster, F. B., Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Entwistle, James L., Pawtucket, R. I.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Manufacturing Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
Ajax Manufacturing Co., Cleveland, O.
American Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Wire Measuring
Durant Mfg. Co., Milwaukee, Wis.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Wood Screw
National Machinery Exchange (Used), New York, N. Y.

MACHINERY—Wrapping Wire
Terkelsen Machine Co., Boston, Mass.

MATERIAL HANDLING EQUIPMENT
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

MILLS—Tandem Rolling and Edging
Standard Machinery Co., Providence, R. I.
Torrington Manufacturing Co., The, Torrington, Conn.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.

OILS—Wire Drawing
Richards, G. Whitfield, Philadelphia, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

OVENS—Industrial
Carl-Mayer Corp., The, Cleveland, Ohio
Ross, J. O., Engineering Corp., New York, N. Y.

PANS—Lead and Spelter
National Annealing Box Co., Washington, Penna.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Creped Wrapping
Crepe-Kraft Co., Newark, N. J.

PAPER TESTERS—
Scott, Henry L., Co., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COILS AND JETS—Steam
Heil & Co., Cleveland, Ohio

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

PICKLING TANK LININGS—
Keagler Brick Co., Steubenville, Ohio

PIPING AND FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

PLASTIC TESTERS—
Scott, Henry L., Co., Providence, R. I.

POTS—Lead Melting
Robertson, John, Co., Brooklyn, N. Y.

POWDER—Wire Drawing
Richards, G. Whitfield, Philadelphia, Pa.

PRESSES—Hydraulic and Mechanical
Robertson, John, Co., Brooklyn, N. Y.
Standard Machinery Co., Providence, R. I. (Mechanical Only)

PRESSES—Lead
Robertson, John, Co., Brooklyn, N. Y.

PRESSURE VESSELS—
National Annealing Box Co., Washington, Penna.

PULLERS—Wire
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
Robertson, John, Co., Brooklyn, N. Y.

RECORDERS—Fault and Reel
Entwistle, James L., Pawtucket, R. I.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Moslo Machinery, Inc., Cleveland, Ohio
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Manufacturing Co., The, Torrington, Conn.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery, Inc., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Steel
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS AND SPOOLS—Shipping and Shop
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Takeoff
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery, Inc., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Vulcanizing and Impregnating
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery, Inc., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio
Moslo Machinery, Inc., Cleveland, Ohio
Ross, J. O., Engineering Corp., New York, N. Y.

RODS—Wire—Non-Ferrous
American Brass Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Steel Corp., Kansas City, Mo.

ROLL STRAIGHTENERS—
Moslo Machinery, Inc., Cleveland, Ohio

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott, Henry L., Co., Providence, R. I.

RUST PROOF COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
American Lanolin Corp., Lawrence, Mass.

RUST REMOVING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.

SOAPS—Industrial and Wire Drawing
Standard Industrial Compounds Co., Chicago, Ill.

SPARK TESTING EQUIPMENT—
Entwistle, James L. Pawtucket, R. I.

SPOOLS—Annealing and Wire Drawing
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

SPOOLS—Shipping and Shop
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

SPOOLS—Steel
American Pulley Co., Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

STAMPINGS—Steel
Hubbard Spool Co., Chicago, Ill
Mossberg Pressed Steel Corp., Attleboro, Mass.

STEAM COILS AND JETS — For Acid Tanks
Heil & Co., Cleveland, Ohio

STRIP—Brass and Non-Ferrous
American Brass Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.

STRIP METAL TESTERS—
Scott, Henry L., Co., Providence, R. I.

SWIFTS—Take-off
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TAKE-UPS FOR CABLE, HOSE, LEAD PRESSES AND SHEET RUBBER—
Entwistle, James L., Pawtucket, R. I.

TANK LININGS—Brick
Keagler Brick Co., Steubenville, Ohio.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

TANKS—Pickling
Haveg Corp., Newark, Del.
Heil & Co., Cleveland, Ohio

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

TENSILE TESTERS—
Scott, Henry L., Co., Providence, R. I.

TESTING INSTRUMENTS—
Entwistle, James L., Pawtucket, R. I.
Scott, Henry L., Co., Providence, R. I.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS—
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS—
Ruesch, H. J., Machine Co., Newark, N. J.

TURKS HEADS—Friction and Power Driven
Standard Machinery Co., Providence, R. I.

VALVES AND FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.
Heil & Co., Cleveland, Ohio

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Micro Products Co., Chicago, Ill.
Moslo Machinery, Inc., Cleveland, Ohio

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Steel Corp., Kansas City, Mo.

WIRE DRAWING—High Grade Custom
Hy-Carbo Steel Co., Lowell, Mass.

WIRE—Electric
American Brass Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.

WIRE—Enameled for Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE-MANUFACTURERS—
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Steel Corp., Kansas City, Mo.

WIRE—Nickel Silver and Phosphor Bronze
American Brass Co., The, Waterbury, Conn.
Callite Tungsten Corp., Union City, N. J.
Hudson Wire Co., Ossining, N. Y.

WIRE—Non-Ferrous to Specification for Special Purposes
American Brass Co., The, Waterbury, Conn.
Callite Tungsten Corp., Union City, N. J.
Hudson Wire Co., Ossining, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
American Brass Co., The, Waterbury, Conn.
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Steel Corp., Kansas City, Mo.

WIRE—Stainless Steel
Callite Tungsten Corp., Union City, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Steel Corp., Kansas City, Mo.

WIRE AND STRIP—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE TESTERS—
Scott, Henry L., Co., Providence, R. I.

WIRE, WEAVING—Non-Ferrous
American Brass Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.

WRAPPING PAPER—Creped
Crepe-Kraft Co., Newark, N. J.

YARN TESTERS—
Scott, Henry L., Co., Providence, R. I.

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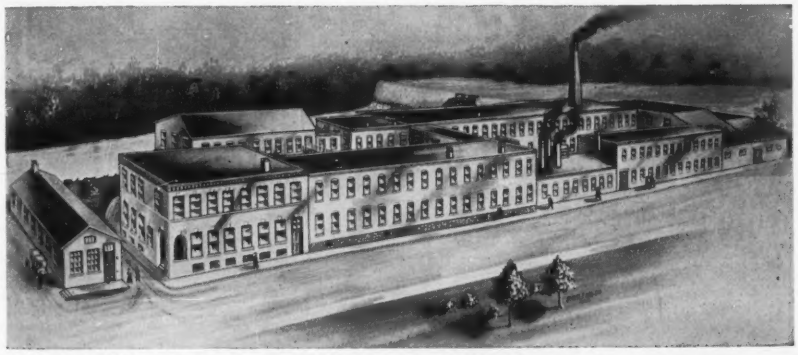

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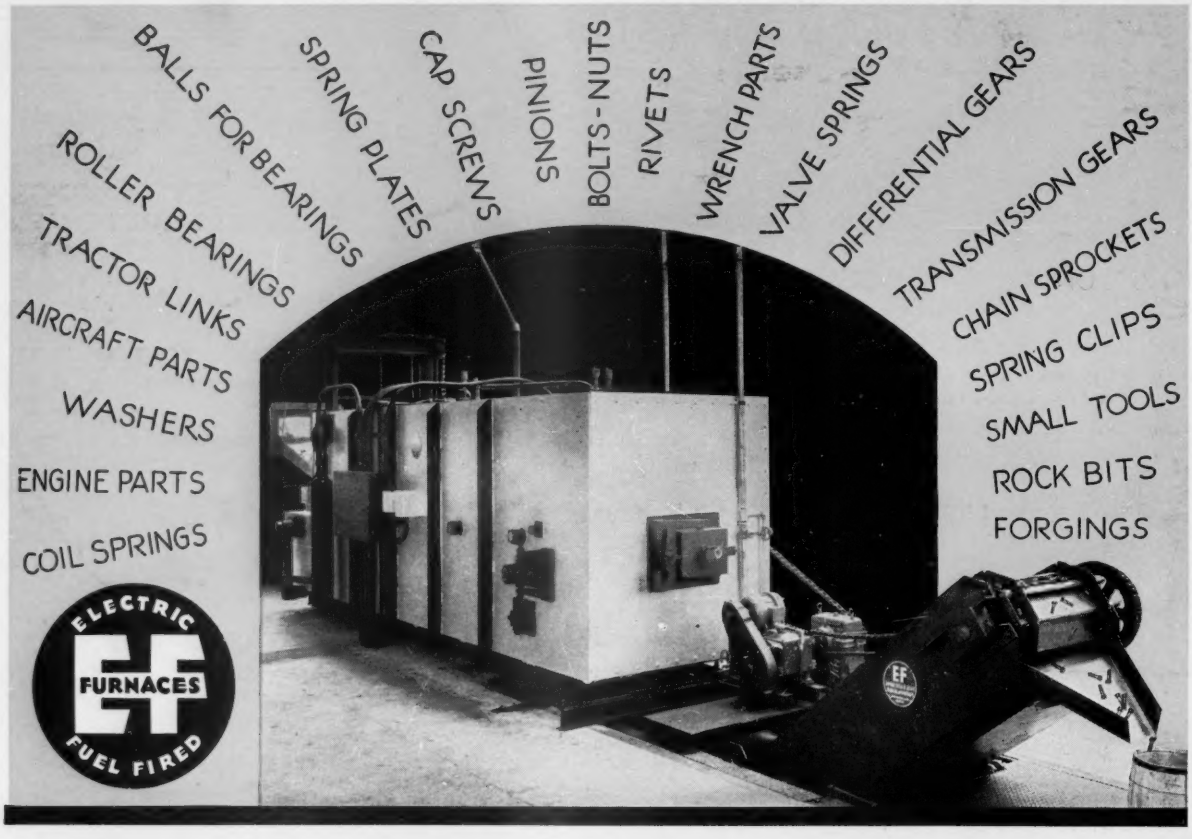

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